NIDEK

AUTO REF/KERATOMETER

AR-600/ARK-700 SERIES

SERVICE MANUAL

(For adjustment)

NIDEK CO., LTD.

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Table of Contents

Page

§1 **PRECAUTIONS** **1-1**

§2 **TROUBLESHOOTING** **2-1**

§3 **SUB TROUBLESHOOTING** **3-1**

3.1 Can Not Perform the AR Measurement Normally 3-1
3.2 Can Not Perform the KM Measurement Normally 3-2

§4 **ADJUSTMENT** **4-1**

4.1 Optical Axis Adjustment of Phototransmitter /Photoreceptor 4-1
4.2 Optical Axis Adjustment of Chart 4-3
4.3 Three-Point Relation among SPD, Mask and LED 4-6
4.3.1 Check of three-point relation among SPD, mask and LED 4-6
4.3.2 Perpendicular adjustment of SPD and mask photoreceptors 4-8
4.3.3 Tilt adjustment of LED lights and mask photoreceptor 4-9
4.3.4 LED adjustment in the middle 4-10
4.3.5 Check after adjustment of three-point relation among SPD, mask and LED 4-11
4.4 Position Adjustment of Reticle and LED lights 4-12
4.5 CYL Value Adjustment 4-12
4.5.1 When the height of the side-by-side waveform is different 4-13
4.5.2 Optical axis adjustment of phototransmitter/ photoreceptor system in horizontal direction 4-14
4.5.3 Optical axis adjustment of phototransmitter/ photoreceptor system in vertical direction 4-16
4.5.4 Check after waveform adjustment 4-17
4.6 Measurable Range Adjustment 4-18
4.7 SPH Value Calibration 4-18
4.8 AR AXIS Adjustment 4-20
4.9 Microcoria Check 4-20
4.10 IOL Check 4-21
4.11 Chart Calibration 4-21
4.12 Internal Reflection Check 4-22

4.13 KM Optical Axis Adjustment 4-23
4.14 KM Calibration 4-29
4.15 KM AXIS Check and Correction 4-30
4.16 Tilt Adjustment of Chart 4-31
4.17 PD Adjustment 4-31
4.18 Auto-Tracking Adjustment 4-33
4.19 Auto-Shot Adjustment 4-34
4.20 Chart Calibration/CYL Lens Adjustment 4-35

§5 **REFERENCE 5-1**

5.1 DIP Switch Function Table 5-1
5.2 Error Code Table 5-2
5.3 Switch Operation at Power ON 5-3

§1 PRECAUTIONS

- This manual describes the adjustment method of the NIDEK AR-600/ARK-700 series.

- This manual is intended for references of engineer training and adjustment by trained personnel.

- Only qualified personnel who received the necessary training should perform repair and adjustment of the system.
  Others must not make the adjustment. Otherwise, an accident or a failure may result.

- If a malfunction occurs, turn the system off after checking the symptom.

- Be careful not to drop the metallic parts such as a removed screw and parts into the system.

- If the screw with a threadlocker is loosened, apply a threadlocker again before tightening the screw.

Turn the system on. Does the initialization start without the Err at the startup?
(The Err appears at the AR or KM measurement, or the measured value is out of the standard.)

No ⇨ A board etc. may fall because of the malfunction other than the adjustment.
Repair the system according to the AR-600/ARK-700 series Service Manual (No. MAR10RTZ001).

Yes ⇩

Perform the AR measurement with a model eye and a human eye.
Can the AR measurement be performed normally?

No ⇨ 3.1 Can Not Perform the AR Measurement Normally.

Yes ⇩

Perform the KM measurement with a KM steel ball.
Can the KM measurement be performed normally?

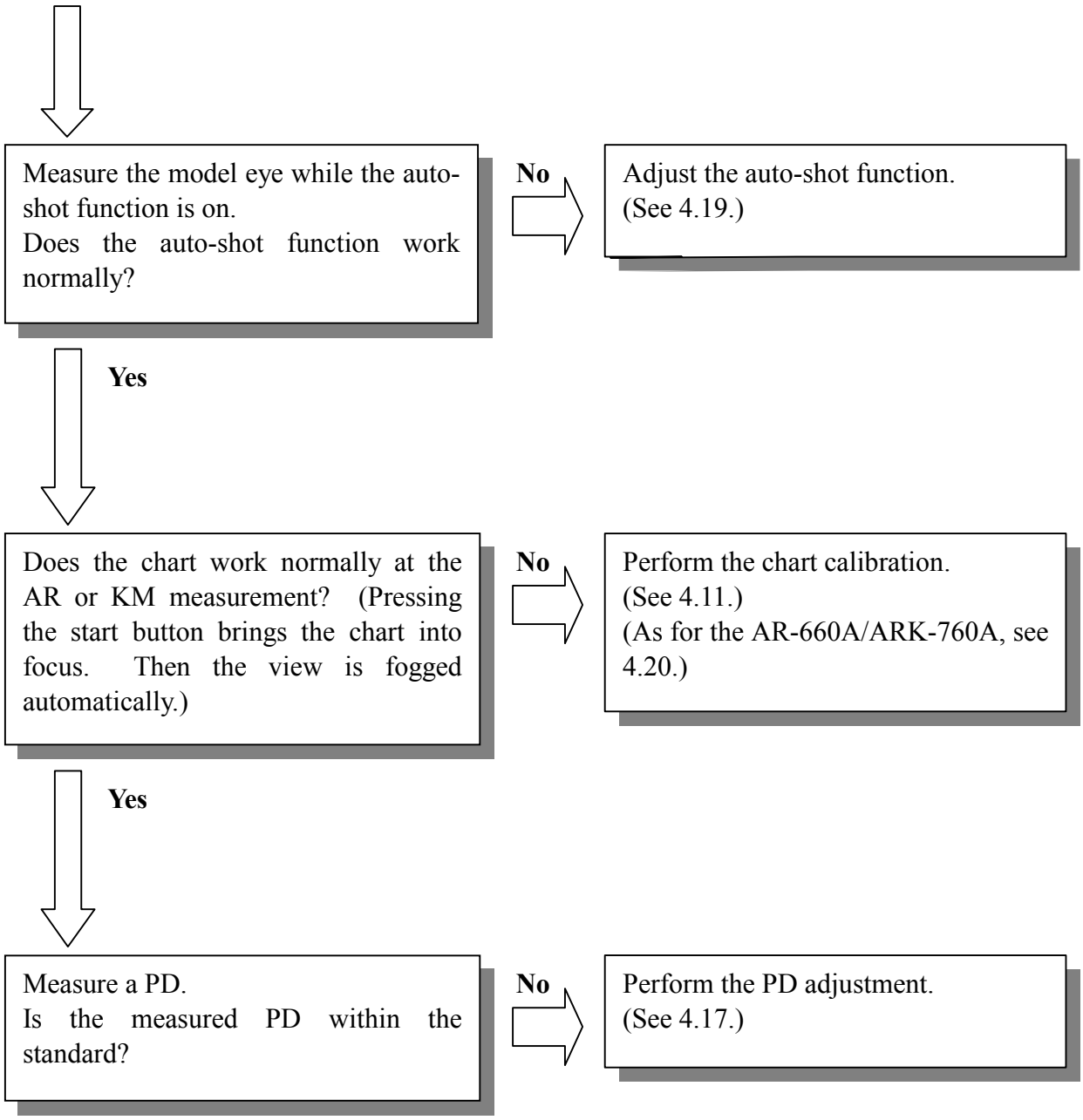
No ⇨ 3.2 Can Not Perform the KM Measurement Normally.

Yes ⇩

Measure the model eye while the auto-tracking function is on.
Does the auto-tracking function work normally?

No ⇨ Perform the auto-tracking adjustment. (See 4.18.)

Yes ⇩


Measure the model eye while the auto-shot function is on.
Does the auto-shot function work normally?
No
Adjust the auto-shot function.
(See 4.19.)
Yes
Does the chart work normally at the AR or KM measurement? (Pressing the start button brings the chart into focus. Then the view is fogged automatically.)
No
Perform the chart calibration.
(See 4.11.)
(As for the AR-660A/ARK-760A, see 4.20.)
Yes
Measure a PD.
Is the measured PD within the standard?
No
Perform the PD adjustment.
(See 4.17.)

3.1 Can Not Perform the AR Measurement Normally.

Measure the model eye.
Can the measure be performed even if the measured value is out of the standard?

No

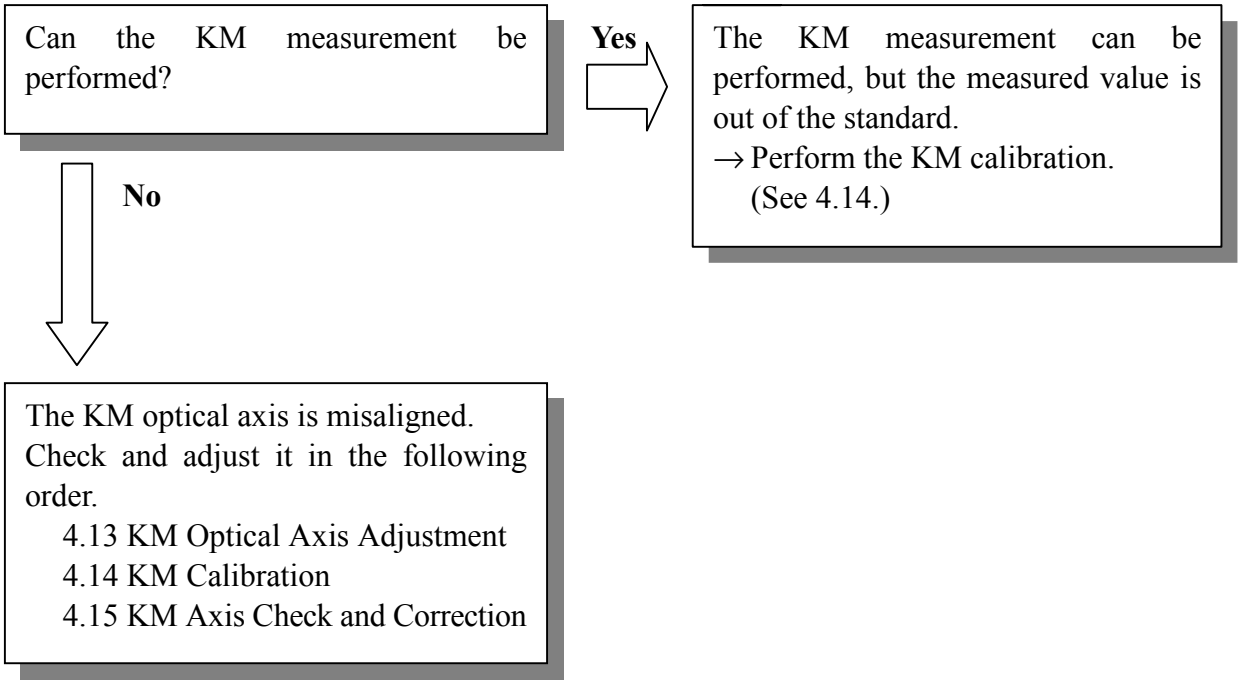
The SPH value is out of the standard.
→ Perform the SPH calibration.
(See 4.7.)

The CYL value is out of the standard.
→ Check and repair the system in the following order.
- 4.5 CYL Value Adjustment
- 4.6 Measurable Range Adjustment
- 4.7 SPH Value Calibration
- 4.8 AR AXIS Adjustment
- 4.9 Microcoria Check
- 4.10 IOL Check
- 4.11 Chart Calibration
- 4.12 Internal Reflection Check
- 4.18 Auto-Tracking Adjustment
- 4.19 Auto-Shot Adjustment

Yes

Check and perform the adjustment in the following order.
- 4.3 Three-Point Relation among SPD, Mask and LED
  (* When the three-point relation is misaligned widely in the item 4.3, perform the adjustment in the order of 4.1 → 4.2 → 4.3.)
- 4.5 CYL Value Adjustment
- 4.6 Measurable Range Adjustment
- 4.7 SPH Value Calibration
- 4.8 AR AXIS Adjustment
- 4.9 Microcoria Check
- 4.10 IOL Check
- 4.11 Chart Calibration
- 4.12 Internal Reflection Check
- 4.18 Auto-Tracking Adjustment
- 4.19 Auto-Shot Adjustment

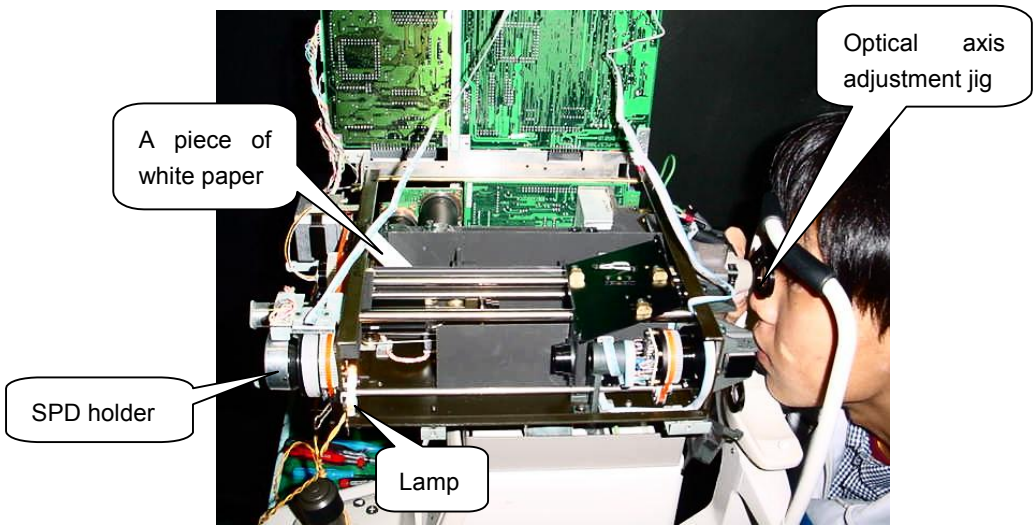
3.2 Can Not Perform the KM Measurement Normally.


Can the KM measurement be performed?
Yes
The KM measurement can be performed, but the measured value is out of the standard.
→ Perform the KM calibration.
(See 4.14.)
No
The KM optical axis is misaligned.
Check and adjust it in the following order.
4.13 KM Optical Axis Adjustment
4.14 KM Calibration
4.15 KM Axis Check and Correction

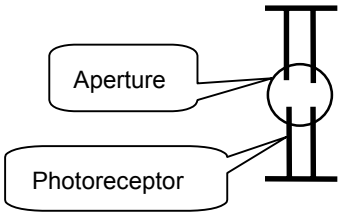
4.1 Optical Axis Adjustment of Phototransmitter /Photoreceptor

[Optical axis check of phototransmitter/photoreceptor]

1. **Attach a lamp in front of the SPD holder to illuminate the photoreceptor.**
2. **Put a piece of white paper in front of the LED.**
3. **Attach the optical axis adjustment jig (ARMJ-7).**
4. **Turn the SPD holder to make the photoreceptor horizontal.**



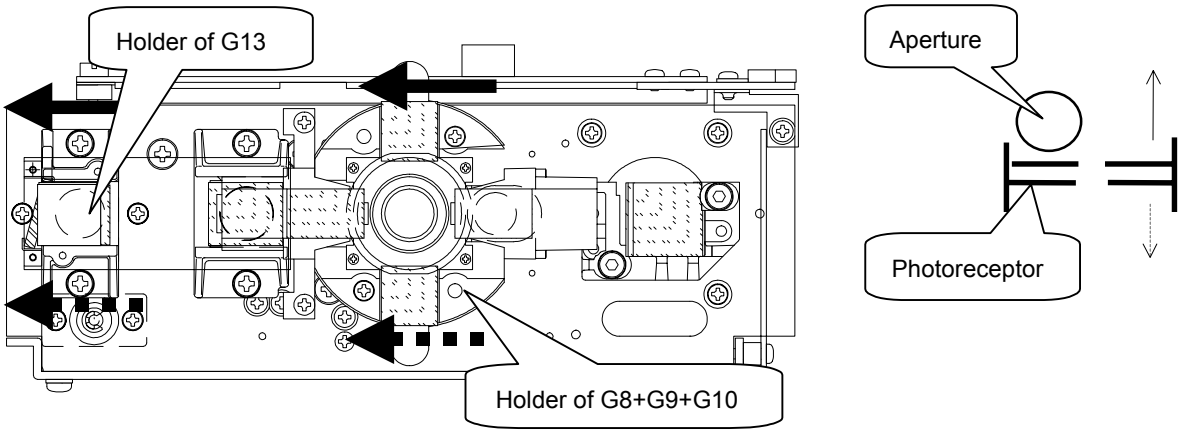
5. **If the positions of the photoreceptor and aperture are not as the right figure shows, perform the [Optical axis adjustment of phototransmitter/photoreceptor].**



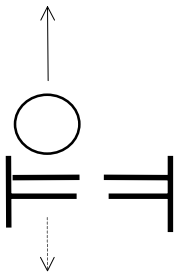
[Optical axis adjustment of phototoransmitter/phototreceptor]

First, align the photoreceptor height.

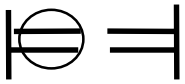
1. **Turn the holder of G13 to align the photoreceptor height at –12D with the aperture.**
   * See Figure on page 4-3 for the –12D position.



2. **Turn the holder of G8+G9+G10 to align the photoreceptor height at +12D with the aperture center.**



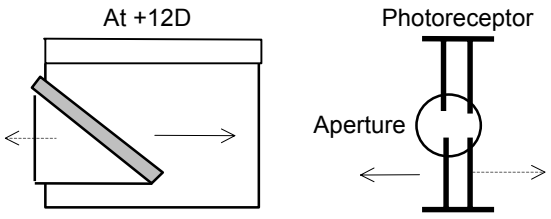
3. **Repeat Step 1 and 2 to align the photoreceptor height with the aperture center.**

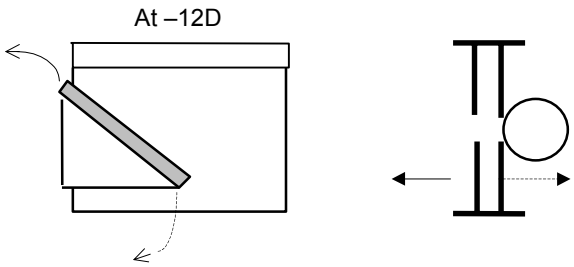


[Adjustment of photoreceptor in horizontal direction]

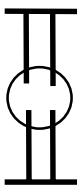
1. **Turn the SPD holder 90º to make the photoreceptor vertical.**

2. **Move G13 to make a horizontal alignment of the photoreceptor at +12D and –12D with the aperture.**
   * Turn G13 at –12D and move parallel at +12D.



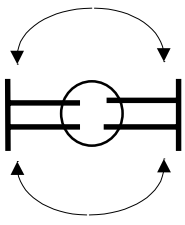


3. **Repeat Step 2 until the photoreceptor is horizontally aligned with the aperture center.**



[Important]

1. Tighten the set screws (n=3) on the top of G13 holder evenly, paying attention to the displacement in the horizonal direction.
2. If there is a displacement in the vertical direction, make an adjustment by turning G13 holder again.
3. G13 is not out of the holder.



4. **Turn the SPD holder and make sure that the photoreceptor is always at the aperture center.**

4.2 Optical Axis Adjustment of Chart

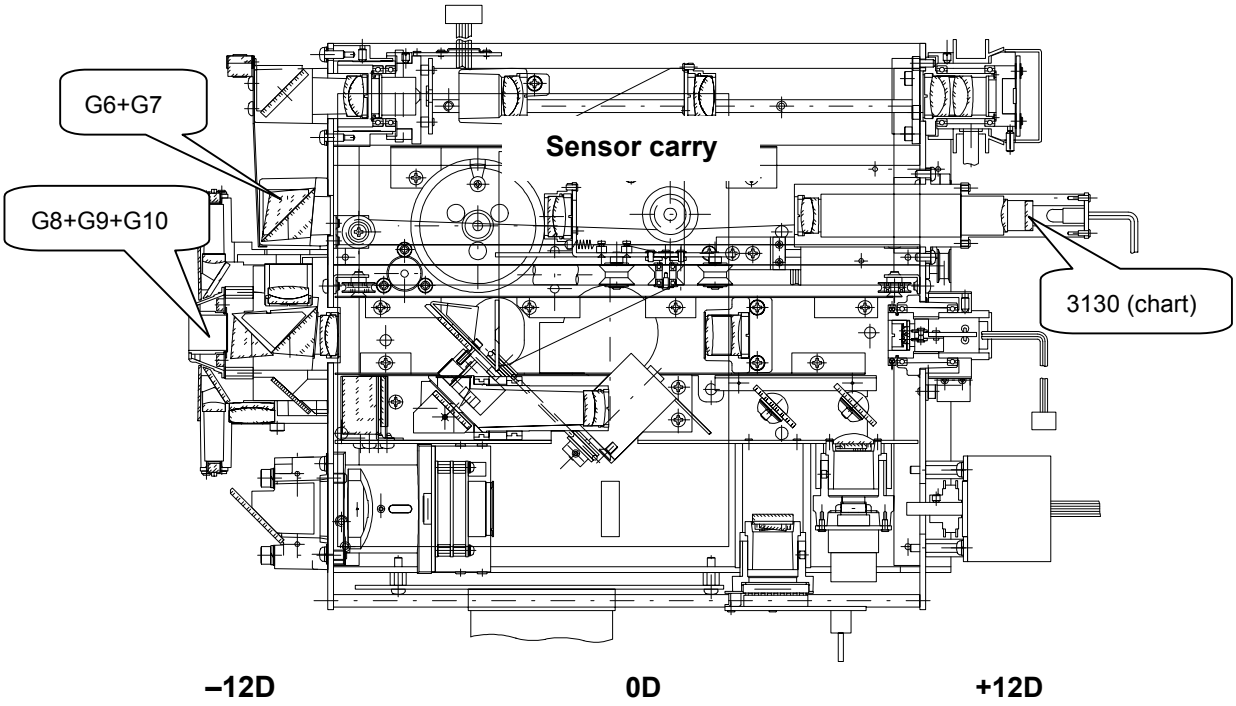
[Optical axis check of chart]

1. **Attach the illumination jig in front of the SPD holder to illuminate the photoreceptor.**
2. **Put a piece of white paper in front of the measuring LED.**
3. **Attach the optical axis adjustment jig (ARMJ-7).**
4. **Set the DIP switch No.4 to the ON position and turn the system on.**
5. **Press (IOL button).**

6. **Look into G8+G9+G10 through the –12D magnifier and move the sensor carry until the chart is focused.**

<Reference>

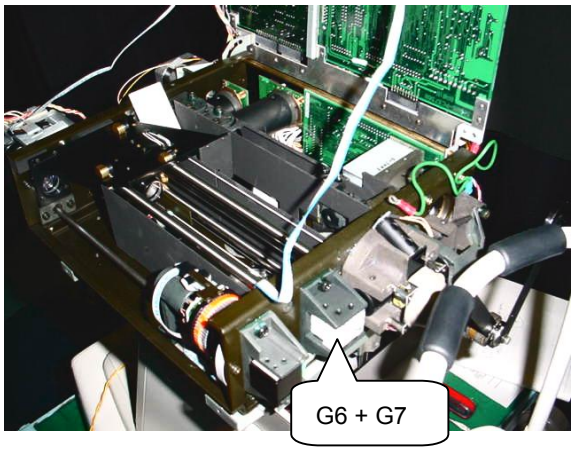
- Where both the chart and aperture of the sensor carry are focused, looking into G8+9+10 with the naked eye. ⟶ 0D position
- Where both the chart and aperture of the sensor carry are focused, looking into G8+9+10 with the +012D magnifier. ⟶ –12D position
- Where both the chart and aperture of the sensor carry are focused, looking into G8+9+10 with the –12D magnifier. ⟶ +12D position

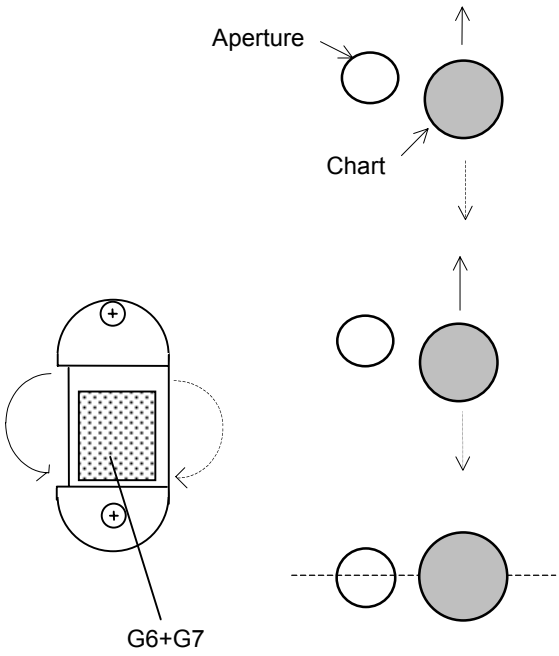


When adjusting the optical axis of the chart, adjust the chart in vertical direction.

[Adjustment of chart in vertical direction]

1. **Turn the holder of G6+G7 to align the chart height at +12D and –12D with the aperture center.**
   * Check at 0D posiiton, as well.

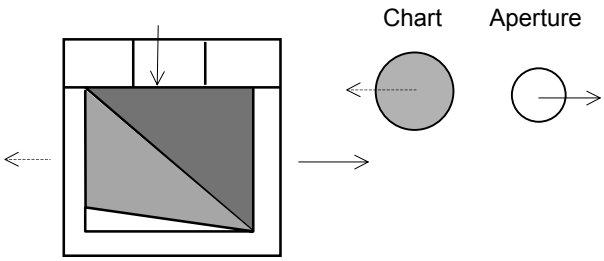




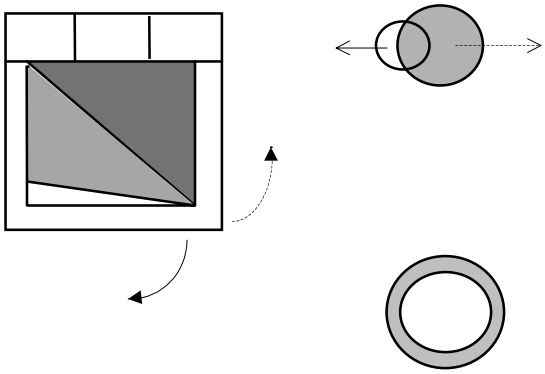
Adjust the chart in horizontal direction.

[Adjustment of chart in horizontal direction]

1. **Move G6 + G7 parallel as the right figure shows to align the chart at –12D with the aperture center.**



2. **Turn G6 + G7 as the right figure shows to align the chart at +12D with the aperture center.**



Repeat Step 1 and 2 until the chart is horizontally aligned with the aperture center.

[Important]

1. When G6 + G7 is fixed with set screws, there may be a displacement in both vertical and horizontal directions.
   In such a case, tighten the screws paying attention to the horizontal direction and turn the holder again if there is a displacement in the vertical direction.
2. The screws (n=3) retaining G6 + G7 shall be tightened evenly.
3. The prism of G6 + G7 is not out of the front of the holder.

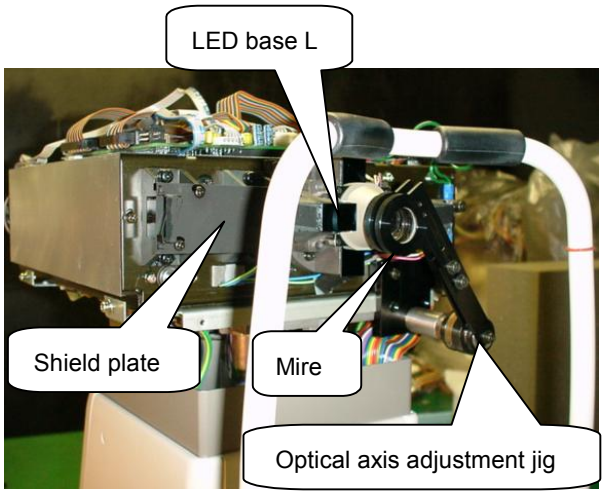
3. Move the entire chart unit until the balloon center is placed within 1/4 of the aperture.

4.3 Three-Point Relation among SPD, Mask and LED

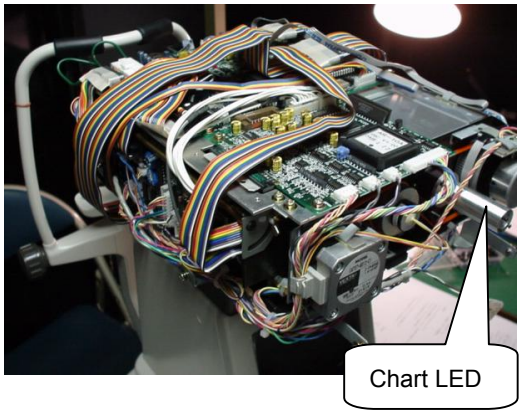
4.3.1 Check of three-point relation among SPD, mask and LED

1. **Remove the shield plate.**
   * The right figure shows ARK-700 series. In the AR-600 series, the shield plate is removed in the same manner.

2. **Remove the LED base L.**
   * The right figure shows ARK-700 series. In the AR-600 series, the LED base L is removed in the same manner.

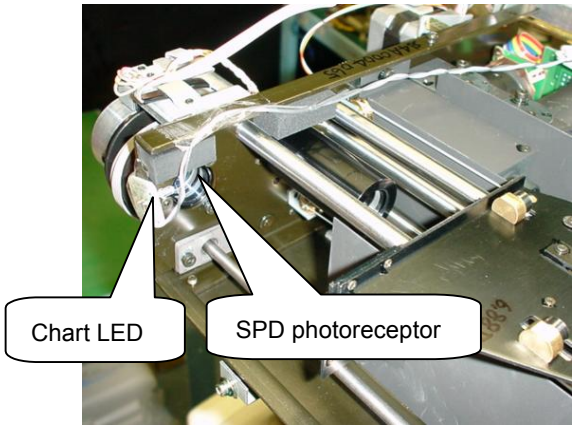


3. **Attach the optical axis adjustment jig (ARMJ-7) on the measuring unit with PC4×14.**
   * Remove the cable cramp.
   * Attach the jig so as not to crush the cable.
   * Adjust the length of the arm by pushing or pulling the arm so that two magnifiers and the mire (measuring window) will be placed in a straight line.
   * The front one is a magnifier of the + power.

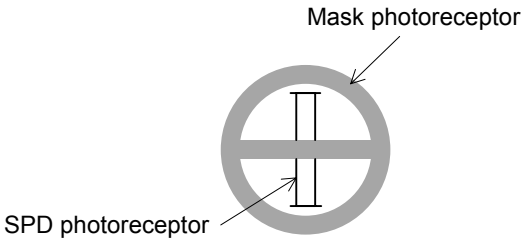


4. **Remove EA15 (chart LED) on 3130 (chart).**
   * The SPD photoreceptor cannot be seen unless the chart LED is turned off.
   * The chart LED is used for illuminating the SPD photoreceptor.
   * If the SPD photoreceptor is illuminated by a pen light, etc., you may disconnect J17 on the PC6 board to turn off the chart LED.

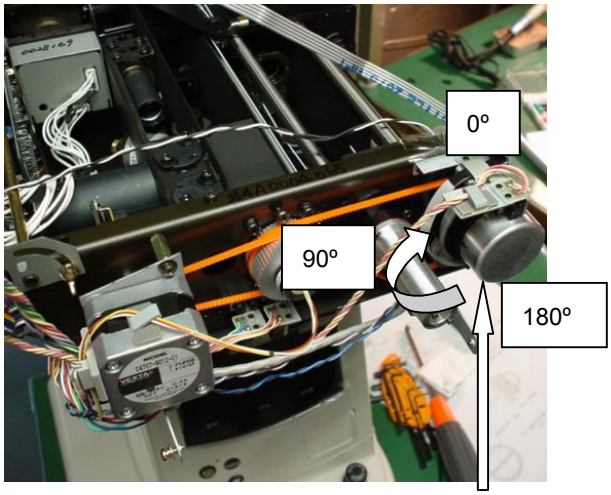
5. **Set the chart LED removed in the previous step in front of the SPD photoreceptor with a tape, etc.**
   * Illuminating the SPD photoreceptor allows you to see an element easily.
   * If it is hard to see with the chart LED, use a pen light, etc.



In Step 6 and 7, make sure that the SPD and mask photoreceptors are perpendicular as the right figure shows.

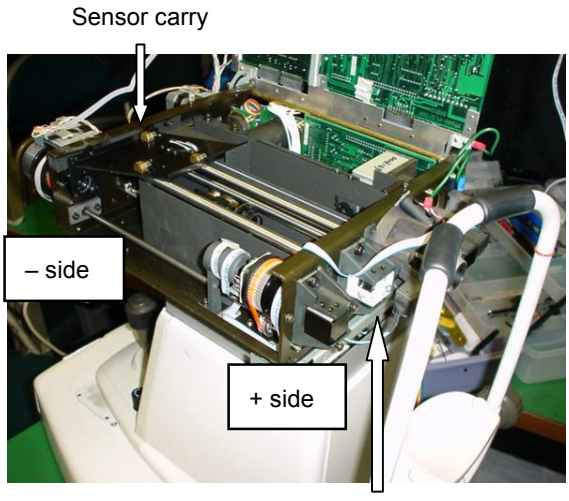


6. **Set the sensor plate on 5047 (SPD unit) at the 0º position (top).**
   * The mask photoreceptor can be seen by looking into G6 + G7 with the naked eye.



Turn the SPD unit in the direction of the arrow.

7. **Move 5035 (sensor carry) to the + side to bring the SPD photoreceptor into focus.**
   * Look into G6 + G7 with the naked eye and make sure that the SPD and mask photoreceptors are perpendicular.



Look into 1651 (G6+G7) with naked eye.

When the SPD and mask photoreceptors are not perpendicular, perform “4.3.2 Perpendicular adjustment of SPD and mask photoreceptors”.

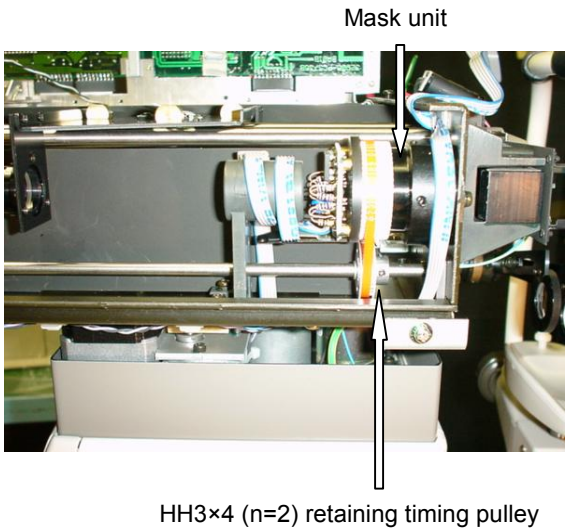
4.3.2 Perpendicular adjustment of SPD and mask photoreceptors

1. **Loosen HH3×4 (n=2) retaining 5041 (timing pulley).**
   * The SPD unit and mask unit turn seperately.

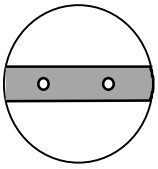
2. **Set the shutter on 5047 (SPD unit) at the 0º position (top).**

3. **Turn the mask unit so that the SPD and mask photoreceptor will be perpendicular.**

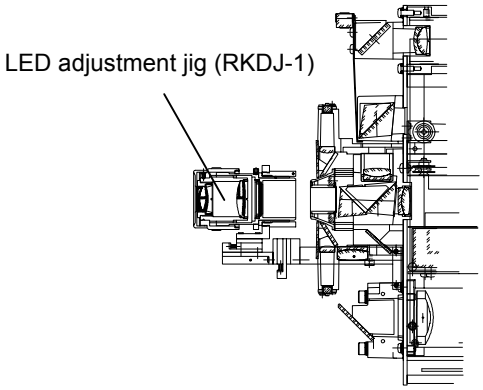
4. **Tighten HH3×4 (n=2) retaining 5041 (timing pulley).**



When the SPD and mask photoreceptors become to be perpendicular, attach the LED adjustment jig (RKDJ-1) to make sure that the LED lights are parallel to the mask photoreceptor.



LED lights are parallel to mask photoreceptor.



* If the LED adjustment jig (RKDJ-1) is not available, it may use the optical axis adjustment jig (ARMJ-7).

When the LED lights are not parallel to the mask photoreceptor, perform “4.3.3 Tilt adjustment of LED lights and mask photoreceptor”.

4.3.3 Tilt adjustment of LED lights and mask photoreceptor

1. **Set the DIP switch No.4 and No.5 on the PC1 board to the ON position.**

2. **Turn the power switch on and press (IOL button).**
   Press the START button on the joystick to place the system in "Test mode 1".

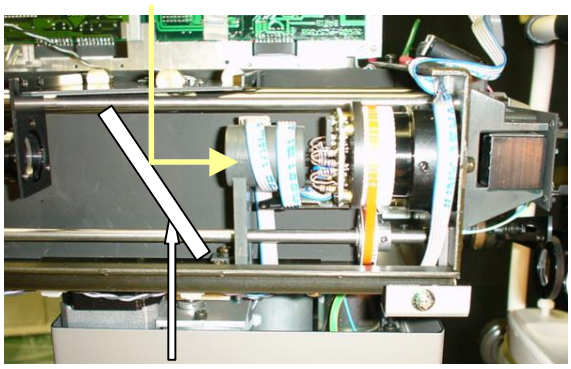
3. **Put a piece of white paper between 5035 (sensor carry) and 5043 (relay lens).**
   * The paper must be tilted so that reflected light will come into the mask unit.
   * The white paper makes it easy to see the mask photoreceptor.
   * This adjustment can be made by attaching EA15 (chart LED lamp) on 5043 (relay lens).

4. **Draw out the + power magnifier of the optical axis adjustment jig (ARMJ-7) about 10 cm and look into G8+G9+G10. Check the position of the LED lights and mask photoreceptor.**
   * The position to be seen differs from the indivisual eyesight.

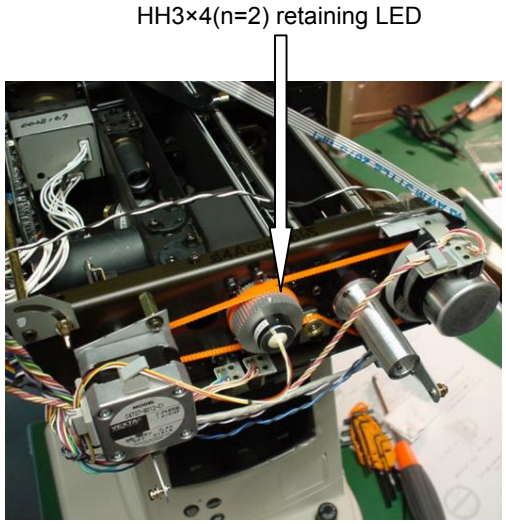
5. **Loosen HH3×4 (n=2) which hold 3110 (LED).**
   * It makes SPD and LED turn seperately and only LED lights turns.

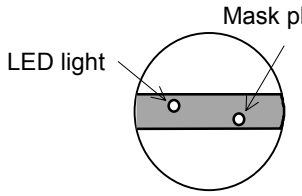
6. **Look into G8+G9+G10 with the + power magnifier of the optical axis adjustment jig (ARMJ-7) and turn 3110 until the LED lights are parallel to the mask photoreceptor.**

7. **Tigten HH3×4 (n=2) retaining 3110 (LED).**

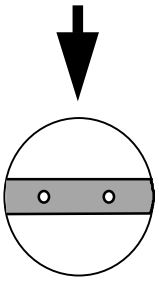


Put a piece of white paper.



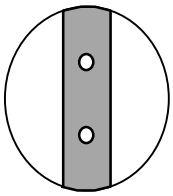


LED lights are not parallel to mask photoreceptor.



LED lights are parallel to mask photoreceptor.

When the LED lights has become to be parallel to the mask photoreceptor, make sure that the LED lights are positioned in the middle of the mask photoreceptor as the right figure shows.
If not, perform "4.3.4 LED adjustment in the middle".



LED lights are in the middle of mask photoreceptor.

4.3.4 LED adjustment in the middle

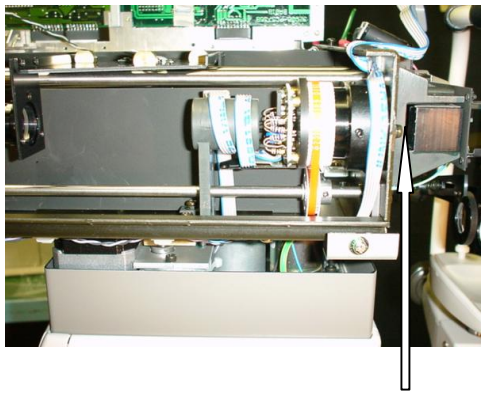
1. **Loosen PC3×8 (n=2) retaining 5065 (mask unit).**

2. **Set the sensor plate on 5047 (SPD unit) to the 90º position (left side).**

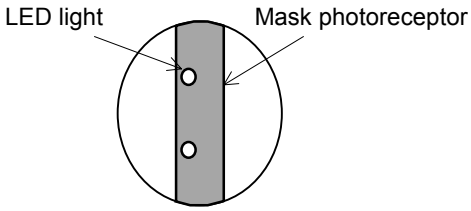
3. **Look into G8+G9+G10 with the + power magnifier of the optical axis adjustment jig (ARMJ-7) and move 5065 (mask unit) to the right or left side so that the LED lights will be positioned in the middle of the mask photoreceptor.**
   * Then, be sure not to fail the parallel adjustment of the LED lights by turning the mask unit.

4. **Turn 5047 (SPD unit) from 0º to 180º and make sure that the LED lights are always positioned in the middle of the mask photoreceptor.**

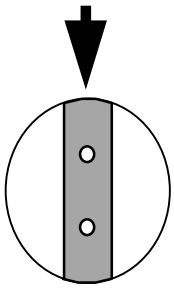
5. **Tighten PC3×8 (n=2) retaining 5065 (mask unit).**



Screw retaining mask unit



LED lights are out of the middle of mask photoreceptor.



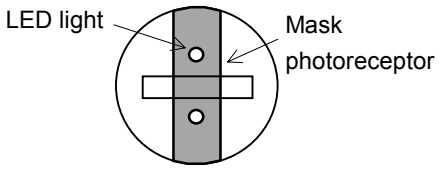
LED lights are in the middle of mask photoreceptor.

After “4.3.2 Perpendicular adjustment of SPD and mask photoreceptors”, “4.3.3 Tilt adjustment of LED lights and mask photoreceptor” and “4.3.4 LED adjustment in the middle”, perform “4.3.5 Check after adjustment of three-point relation among SPD, mask and LED”.

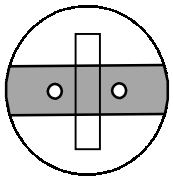
4.3.5 Check after adjustment of three-point relation among SPD, mask and LED

1. **Turn 5047 (SPD unit) from 0º to 180º and make sure that the following conditions are met at all times.**
   When all conditions are met, the relation among SPD, mask and LED is normal.
   - The SPD and mask photoreceptors are perpedicular.
   - LED lights are parallel to the mask photoreceptor.
   - LED lights are positioned in the middle of the mask photoreceptor.

   If only the one of conditions is not met, perform the adjustment from 4.3.1 to 4.3.4 again.



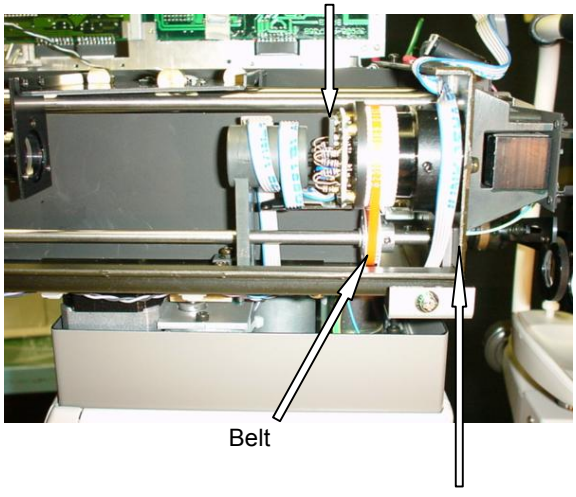
SPD unit is 0º or 180º.


SPD unit is 90º.

2. **Make sure that the following three requirements are met.**
   - 5047 (SPD unit) is at the 0º position (top).
   - Operation amplifier of 5065 (mask unit) is top.
   - Set screw (TG2×3) of 3110 (LED) is top.

3. **Loosen PC3×8 (shaft mounting screw) (n=2) to move the shaft up and down and then adjust the tension of the belt.**
   * Make this adjustment when 5065 (mask unit) is moved.
     Moving 5065 (mask unit) changes the tension of the belt.
   * The belt shall be sagged by 3 - 5 mm when pressed with 50 - 150g.
   * Adjust the tension with 5047 (SPD unit) at the 180º position.

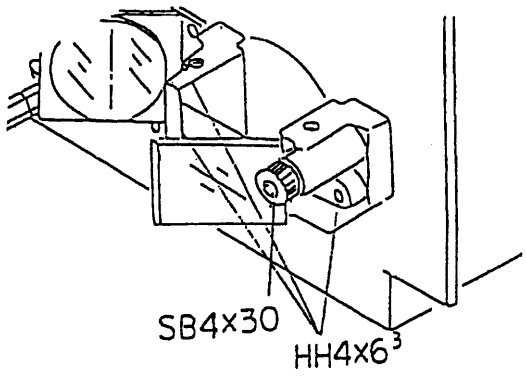
Operation amplifier is top.



4.4 Position Adjustment of Reticle and LED Lights

Since the front cover is removed, the surroundings may be too bright. It saturates the TV screen and makes the reticle unclear. Make this adjustment in dark surroundings.

1. **Set the DIP switch No.4 to the ON position to place the system in the adjustment mode and establish "MODE 10-0".**
2. **Loosen SB4×30 and turn the holder to adjust the height so that two LED lights will come to the center (cross) of the monitor.**
   Tighten or loosen HH4×6 to adjust the horizontal direction.



4.5 CYL Value Adjustment

Oscilloscope is required for the CYL waveform check. Before this check, perform Step 1 to 4 as the preparation.

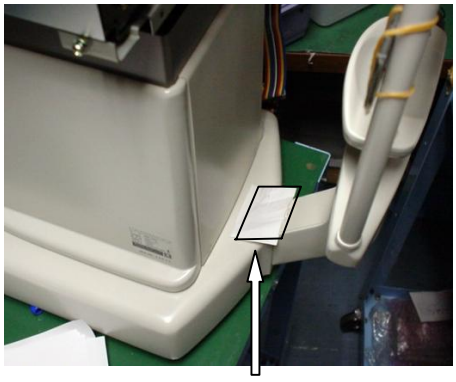
1. **Attach the non-cemented model eye (RKDJ-1 0900) onto the chin rest.**

2. **Cover the LED for the PD measurement on the base.**

3. **Set an oscilloscope as follows.**

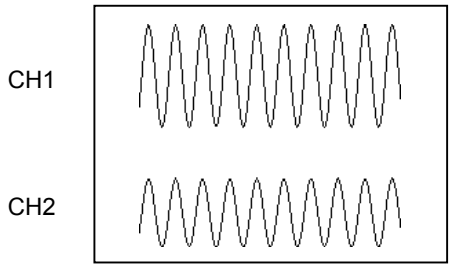
CH1 probe: TP5(SPD CHB) on PC1 CH2 probe: TP6(SPD CHA) on PC1 CH1 alligator forceps: ANALOG GND on PC1 TIME:0.5msec/DIV VOLTS:2V/DIV AC

4. **Darken the room.**
   * If external light gets in the system, correct waveform cannot be observed.



Cover LED for PD measurement with a paper, etc.

Attach the probe to the test pin and make sure that the height of the side-by-side waveform is same. If the height is different, perform "4.5.1 When the height of the side-by-side waveform is different".



4.5.1 When the height of the side-by-side waveform is different

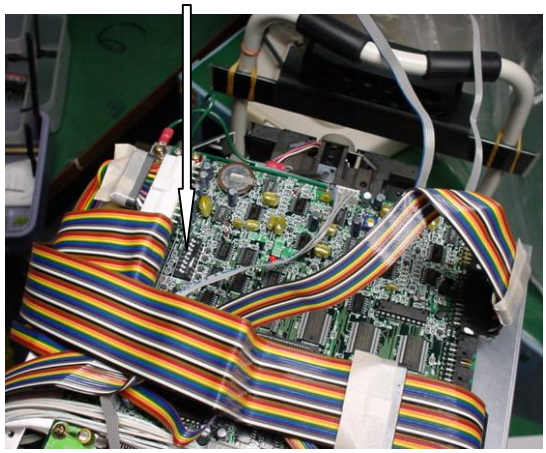
1. **Set the DIP switch No.4 and No.5 to the ON position and press (IOL button).**

2. **Align the system with the –10D model eye and move 5035 (sensor carry).**

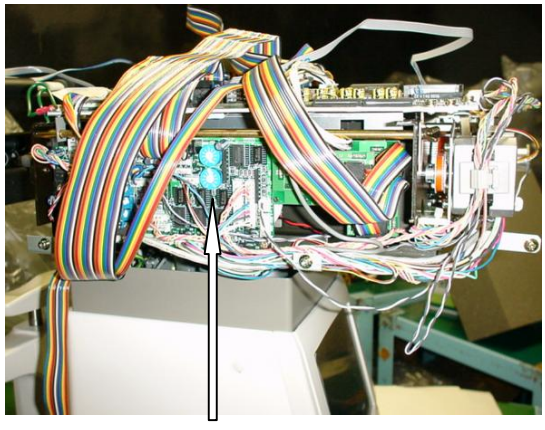
3. **Press the START button on the joystick twice to establish "Test mode 2".**

4. **Set 5047 (SPD unit) to the 90º position (left side).**

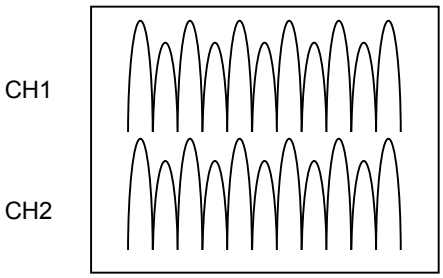
DIP switch on PC1 board



5. **Adjust VR3 or 4 on the PC6 board so that the side-by-side waveform will become the same height on the oscilloscope display signal.**
   * Adjustment of the difference between LED illuminations.
   * With both VR3 and VR4 fully turned counterclockwise, adjust the light quantity to the low one.



VR3 and 4 on PC6 board



When the height of the side-by-side waveform becomes to be same, align the system with –10D model eye and make sure that the waveform is equal in amplitude. If not, perform "4.5.2 Optical axis adjustment of phototransmitter/photoreceptor system in horizontal direction".

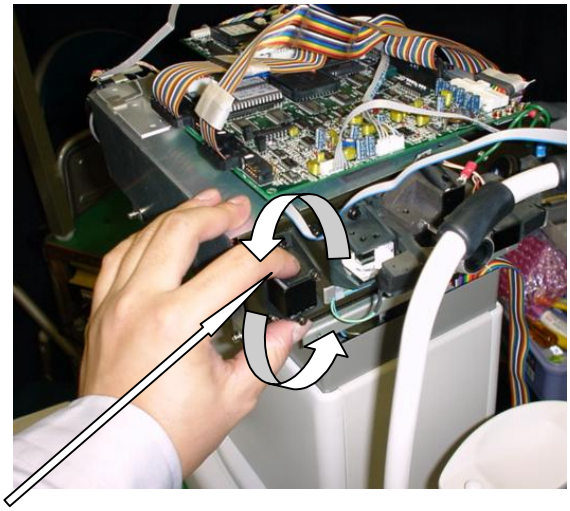
4.5.2 Optical axis adjustment of phototransmitter/ photoreceptor system in horizontal direction

1. **Align the system with the –10D model eye and move 5035 (sensor carry).**

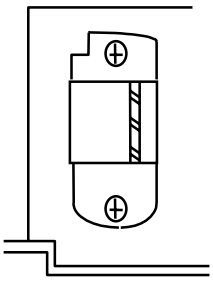
2. **Set 5047 (SPD unit) to the 90º position.**

3. **Loosen PC4×8 (n=2) retaining the holder of 1589 (mirror B).**
   * Too much looseness will move the holder widely and it will make the adjustment hard because of deformed waveforms.
   If the screw is too loose, tighten until it contacts.

4. **Turn the holder of 1589 (mirror B) until the waveforms between CH1 and CH2 become equal in amplitude.**
   * It is hard to adjust the waveform height by turning the holder with a finger.
   Put a flatblade screwdriver on the holder to be turned and turn the holder by hammering the handle for fine adjutment.



Holder of 1589 (mirror B)

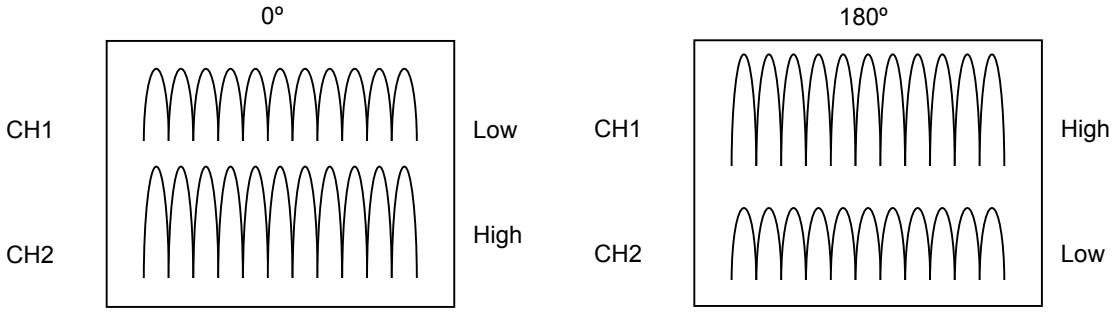


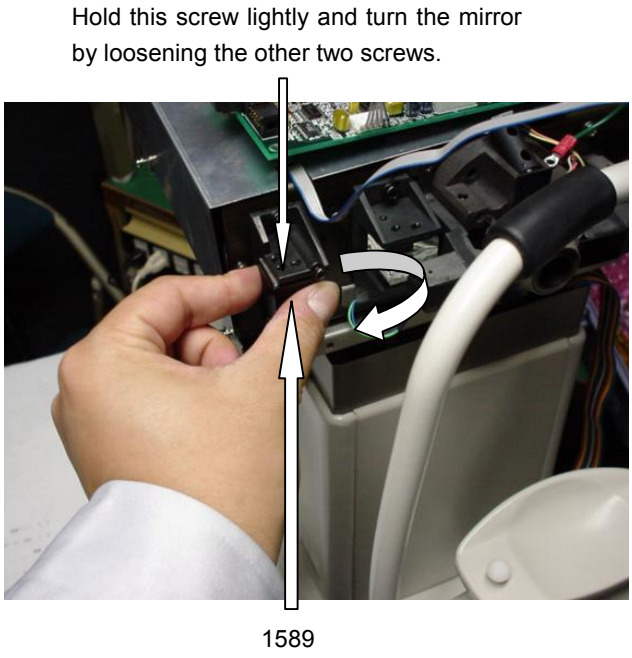
5. Adjust the position of 1589 (mirror B) by loosening the HH screw retaining 1589 (mirror B) until the waveforms between CH1 and CH2 become equal in amplitude when 5047 (SPD unit) is set to the 0º and 180º positions.

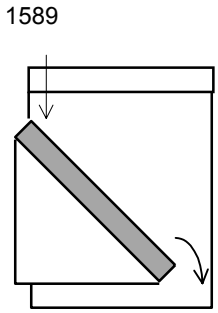
* Optical axis adjustment of the phototransmitter/photoreceptor in the horizontal direction.

* For the waveforms as shown in the figures below, turn 1589 in the direction of the arrow.

* It is hard to adjust the waveform height by turning the holder with a finger.
Put a flatblade screwdriver on the holder to be turned and turn the holder by hammering the handle for fine-adjutment.







After "4.5.2 Optical axis adjustment of phototransmitter/photoreceptor system in horizontal direction", align the system with +10D model eye and make sure that the waveforms become equal in amplitude. If not, perform "4.5.3 Optical axis adjustment of phototransmitter/ photoreceptor system in vertical direction".

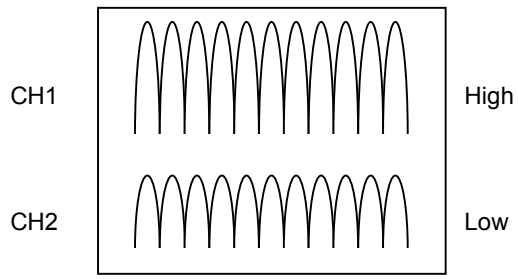
4.5.3 Optical axis adjustment of phototransmitter/ photoreceptor system in vertical direction

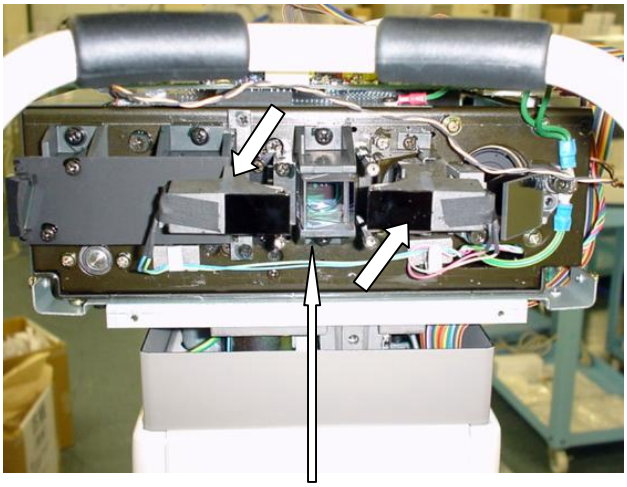
1. **Align the system with the +10D model eye and move 5035 (sensor carry).**

2. **Set 5047 (SPD unit) to the 90º position.**

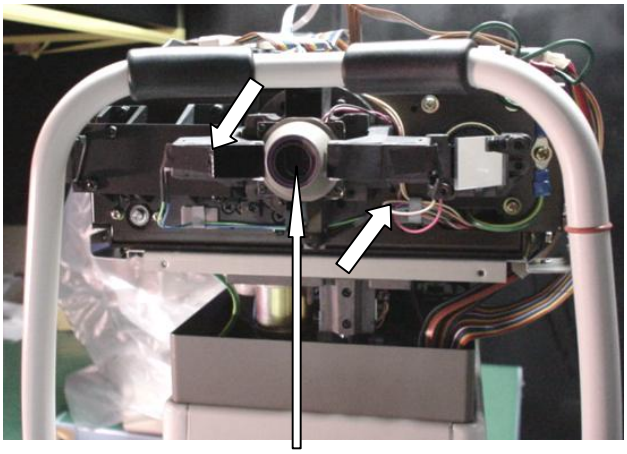
3. **Loosen PC4×8 (AR-600 series) or PC3×15 (ARK-700 series) retaining the holder of GA10 (G8+G9+G10).**
   * Too much looseness will move the holder widely and it will make the adjustment hard because of deformed waveforms.
     If the screw is too loose, tighten until it contacts.

4. **Turn the holder of GA10 (G8+G9+G10) until the waveforms between CH1 and CH2 become equal in amplitude.**
   * Optical axis fine-adjustment of the phototransmitter/photoreceptor in the vertical direction.
   * If the similar figure on the right is obtained, move the holder counterclockwise.
   * It is hard to adjust the waveform height by turning the holder with a finger.
     Put a flatblade screwdriver on the holder to be turned and turn the holder by hammering the handle for fine adjutment.



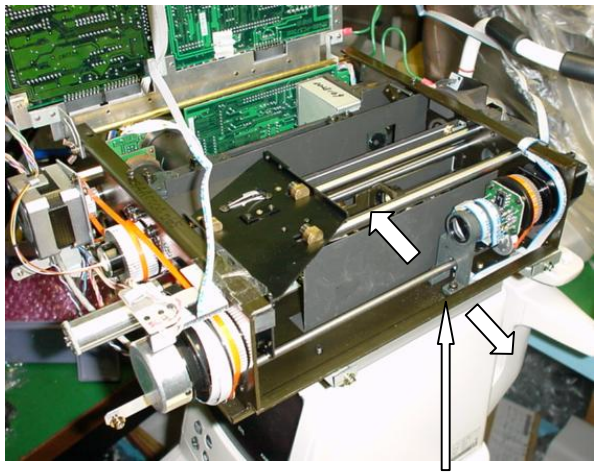


GA10 (G8+G9+G10)
[AR-600 series]



GA10 (G8+G9+G10)
[ARK-700 series]

5. **Adjust the position of 5043 (relay lens) by moving to the right or left until the waveforms between CH1 and CH2 become equal in amplitude when 5047 (SPD unit) is set to 0º and 180º positions.**
   * Never turn 5043 (relay lens).
   It will destroy the waveforms.



6. **Repeat "4.5.2 Optical axis adjustment of phototransmitter/photoreceptor system in horizontal direction" and/or "4.5.3 Optical axis adjustment of phototransmitter /photoreceptor system in vertical direction" at –10D and +10D for the adjustment of waveforms so that the waveform height of CH1 and CH2 will not change when the sensor carry is moved from the + end to the – end.**

   After the CYL value adjustment (4.5.1 to 4.5.3), attach the non-cemented model eye (RKDJ-1 0900) to the chin rest and make sure that the CYL value is within the stadard in the table below.

4.5.4 Check after waveform adjustment

1. **Set the DIP switch No.4 on the PC1 board to the OFF position and measure the model eye in each value.**
   Make sure that the CYL measured values are smaller than the standard values.
   Make an adjustment so that the CYL value will reach the target value which is 1/2 of the standard value.

<CYL standard values>

Model eye value	+22D	+20D	+15D	+10D	+5D	0D	–5D	–10D	–15D	–18D
CYL value	0.40D	0.27D	0.15D	0.12D	0.10D	0.10D	0.10D	0.12D	0.15D	0.23D

Make sure that three points of SPD, mask, and LED are not displaced.
After the CYL adjustment, the three points may be displaced. Be sure to check the positions. After readjusting the three points, make sure that the CYL adjusment is correctly made.
The adjustment of opitcal axis is not completed unless "4.3 Three-Point Relation among SPD, Mask and LED" and "4.5 CYL Value Adjustment" are correctly performed.

4.6 Measurable Range Adjustment

Make sure that the measurable range in the AR-600 series (flasher for alignment) and the ARK-700 series (mire) is horizontally and vertically even when the system is aligned with the 0D model eye. The following conditions must be met.

[AR-600 series]
Make sure that an error does not occur when the flasher for alignment is in the reticle.

[ARK-700 series]
Make sure that an error does not occur when the mire center for alignment is in the reticle.

If the measurable range is not even, readjust the position of the reticle and LED lights.
(See "4.4 Position Adjustment of Reticle and LED lights".)

4.7 SPH Value Calibration

Measure the non-cemented model eye (RKDJ-1 0900). Check whether each SPH values has linearity or not and adjust them according to the following procedures.

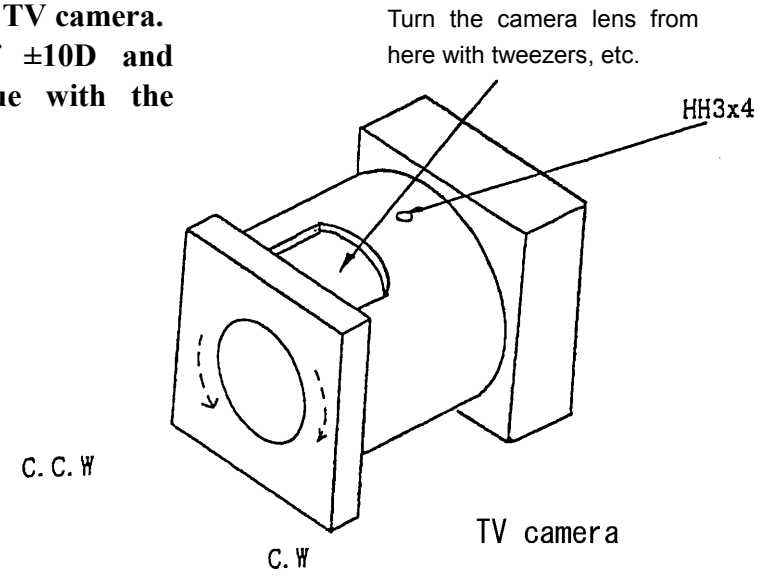
1. **Align the system with the 0D model eye and press the START button to start the measurement.**

2. **Adjust VR2 (S.ZERO) on PC6 with an insulation screwdriver until the measured value on the monitor becomes the same as the calibration value of the model eye.**

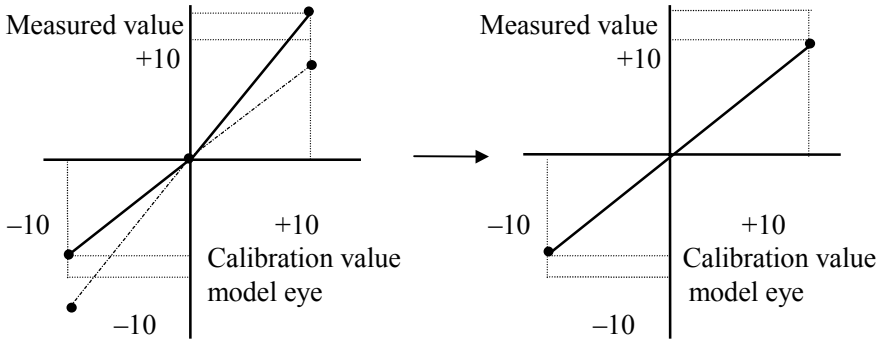
VR2	
Clockwise	Shift to – direction.
Counterclockwise	Shift to + direction

[Linearity of SPH value]

1. **Loosen the set screw retaining TV camera.**
2. **Measure the model eye of ±10D and compare the measured value with the calibration value.**



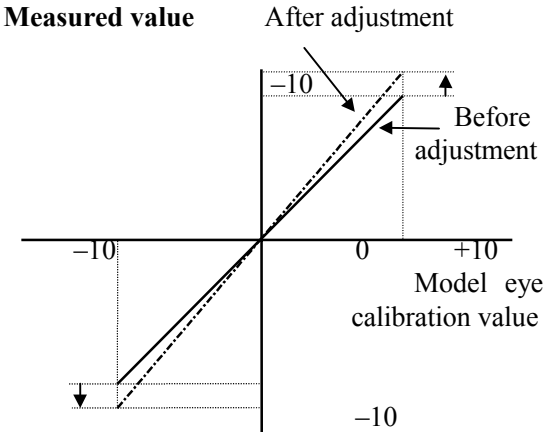
3. When the measured values are shown in valley shape as the figure below, turn the camera lens clockwise to make the line straight.



4. When the measured values are shown in crest shape, turn the camera lens counterclockwise.

5. Adjust VR1 (S.GAIN) on PC6 to match the measured values of ±10D with the calibration values.

VR1 Clockwise Increasing GAIN
Counterclockwise Decreasing GAIN



Repeat the adjustment of the TV camera lens and VR1 until the value reaches the target which is 1/2 of the test standard tolerance.

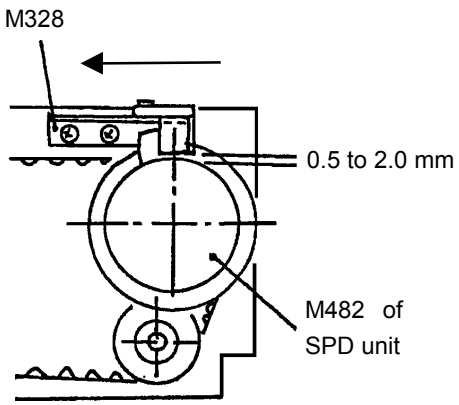
[Test standard]

Model eye	0 D	±5 D	±10 D	±15 D	-18 D	+20 D	+22 D
Tolerance	±0.10D	±0.10D	±0.12D	±0.20D	±0.30D	±0.40D	±0.50D

4.8 AR AXIS Adjustment

Measure the AR AXIS with the AR AXIS model eye (32545-1051) to make sure that this axis is within ±2º.

1. **Align the system with the model eye.**
2. **Press the START button to start the measurement.**
3. **Loosen the set screw retaining M328 (S.W. plate) and adjust the mounting position until the AXIS indications shows 90º. If the axis value is large, move M328 to the arrow direction.**
   Attach M328 so that the clearance to M482 will be 0.5 - 2.0 mm.
4. **Check at 0º, 45º, 90º, and 135º.**
   * Turn the power off and on each time.



4.9 Microcoria Check

Collect data using the cylinder model eye with aperture (32177-1600).

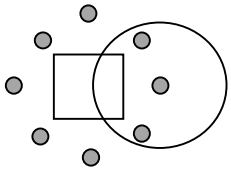
1. **Attach the cylinder model eye with aperture (32177-1600) onto the chin rest**
   * Measurement must be done in "IOL OFF".
2. **Set the AXIS 180º by turning the holder of the model eye of the aperture size 3 mm in diameter.**
3. **With the aperture size 3 mm in diameter, align the external circle of the reticle with the external diameter and make ten measurements for obtaining the typical value.**
   → **3 mm diameter typical value**
4. **With the aperture size 7 mm in diameter in a state that alignment is performed, make ten measurements for obtaining the typical value.**
   → **7 mm diameter typical value**
5. **Figure out the value of (3 mm diameter typical value) – (7 mm diameter typical value).**
   Standard SPH –0.05 to +0.18D (Difference)
   CYL ±0.12D (Difference)

[Microcoria model eye]

4.10 IOL Check

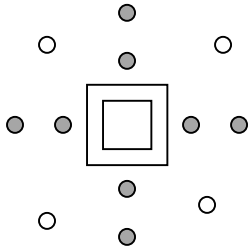
Check that the measurement can be performed in the IOL mode.

1. **Attach the non-cemented model eye (RKDJ-1 0900).**
2. **Press (IOL button).**
3. **Align the system with the +10D model eye and go out of focus in the pushing direction and make sure that an error does not occur when two spots are measured in each direction.**



[ARK-700 series]

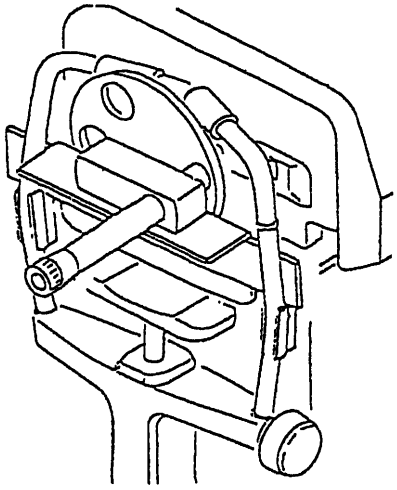
Position to be measured



[AR-600 series]

4.11 Chart Calibration

1. **Adjust the visibility of the dioptric tester.**
2. **Attach the chart calibration jig (ARMJ-6) and turn its rotor plate to align with the model eye for alignment.**
3. **Set the DIP switch No. 4 on PC 1 to the ON position.**
4. **Press the START button to place the system in "MODE 12-0".**
5. **Move the main body forward and backward to align with the model eye.**
6. **Set the rotor plate of the jig at the hole with no object. (0D position adjustment).**
7. **Look into the dioptric tester to bring the chart in focus.**



AR-600 series (Changing button) (IOL button)

ARK-700 series (UP button) (DOWN button)

Ref.)
1. Pressing (UP button) increases the value. * For AR-600, (Changing button)
2. Pressing (DOWN button) decreases the value. * For ARK-700, (IOL button)

* Bring the chart in focus, adjusting from the + side.

8. **Press the START button to establish "MODE 12-1" and set +0012.**
   * The button operation is the same as in "MODE 12-0".
9. **Press the START button to establish "MODE 12-2".**
10. **Turn the rotor plate of the jig to align with the ±12D lens (±12D position adjustment).**
    Press (Print button) to bring the chart in focus.
    * The button operation is the same as in "MODE 12-0".
    * The value when focus is achieved must be between ±12.20 - 11.80.
      If not, establish "MODE 12-1" again and fine-adjust the value.
    * Increase the value if the absolute value is small and decrease the value if large.
11. **Remove the chart calibration jig.**

4.12 Internal Reflection Check

1. **Set the DIP switch No.4 and No.5 to the ON position.**

2. **Press (IOL button) to establish the MODE 1.**

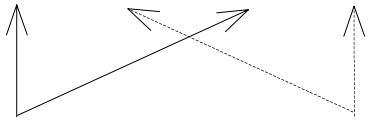
3. **Reflect the LED lights on the matte part and move the main body forward and backward to bring the LED lights into focus.**

4. **Turn the power switch off. Turn the power switch on while holding (Print button) to obtain internal reflection data of 1) and 2) below.**

   1) Move the main body 3 mm to the operator side from the position where focus is achieved.
   2) Move the main body 3 mm to the patient side from the position where focus is achieved.

5. **Make sure that the value difference of the sensor position between 0º and 90º, 45º and 135º is within 250.**

e.g.) +0210 +0200 –0050 +0060



Difference 260 is failure.

Difference 140 is good.
* Pay attention to the sign.

4.13 KM Optical Axis Adjustment

This adjustment must be made to the ARK-700 series only.
Place the system "KM measurement mode" and measure the model eye (steel ball) (R5.00, R5.95, R7.94, R9.13 and R10.00 mm). Check that this result is within the standard below.

Unit: mm

Model eye	R5.00	R5.95	R7.94	R9.13	R10.00
Tolerance	± 0.02	± 0.02	± 0.02	± 0.02	± 0.02
Difference between R1 and R2	0.04	0.04	0.04	0.04	0.04

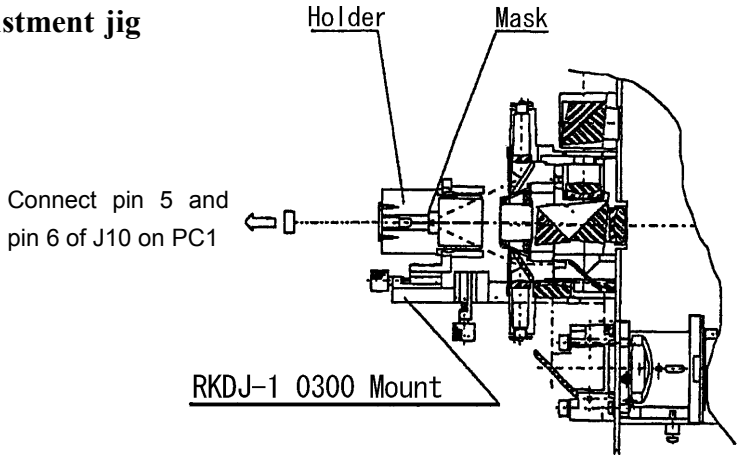
If the measured value is out of the standard, the KM optical axis is misaligned. Adjust the optical axis according to the following procedure.

[Visual check of KM optical axis adjustment]

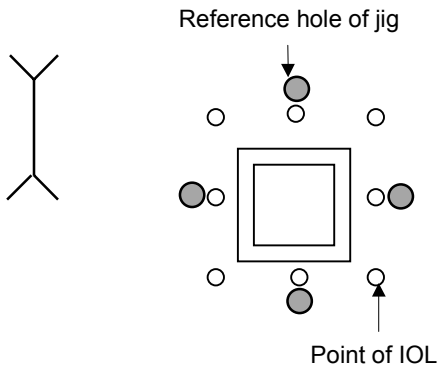
1. **Remove the CCD unit.**

2. **Turn the power switch on and set the DIP switch No.4 to the ON position and then press (R/K button) to place the system in the KM mode.**

3. **Attach the KM optical axis adjustment jig as shown in the right figure.**

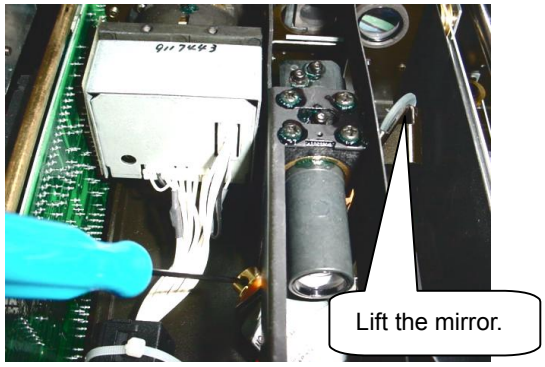


4. **Adjust the position of the jig so that the four reference holes of the jig will be at right angle and concentrically positioned to the reticle.**

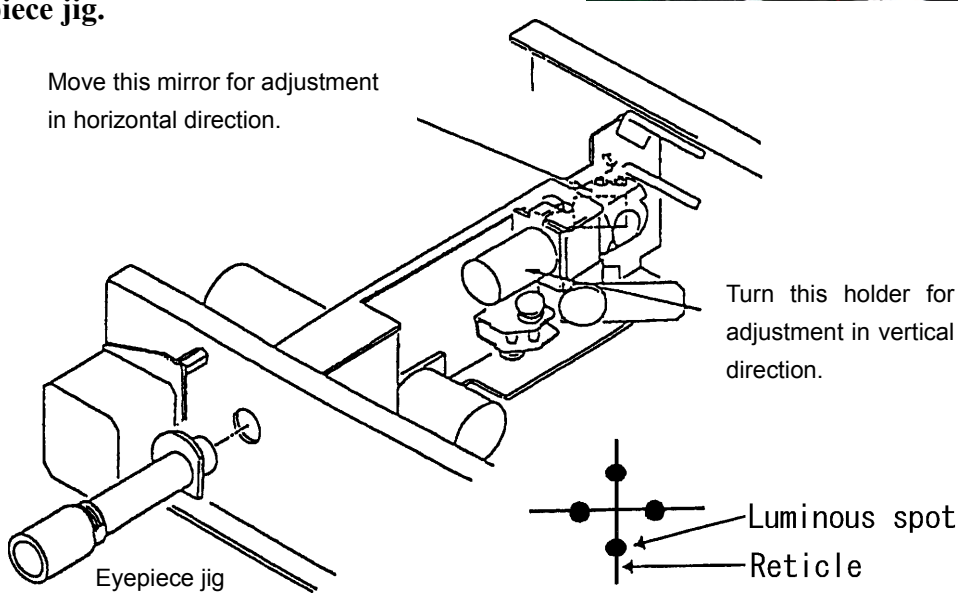


5. **Reduce the VR of the contrast on the TV monitor.**
6. **Disconnect the interface cable and connect the cables of the jig lamp to Pin 5 and Pin 6 of J10 on the PC1.**
7. **Fit the KM optical axis adjustment eyepiece jig to the hole on the rear plate and hold it with hand.**
   * Keep the flange in contact with the rear panel (See the figure on next page.).

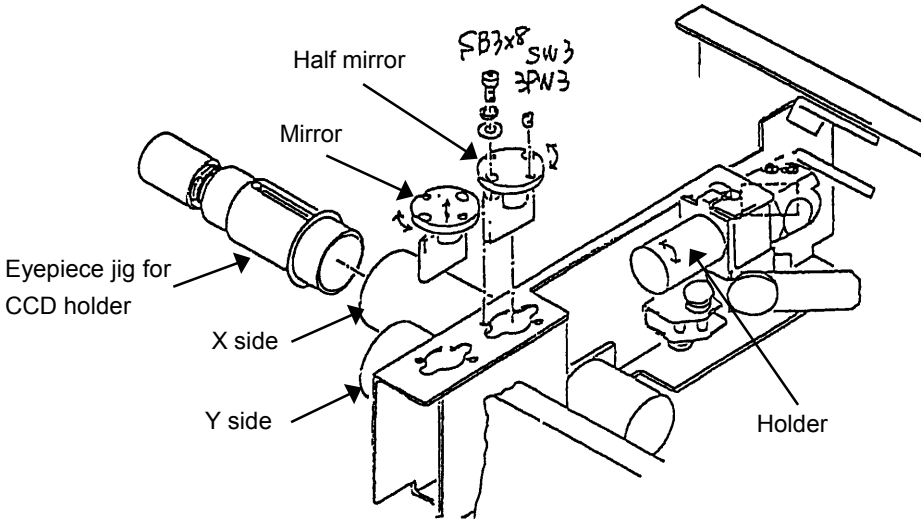
8. **Insert a hexagonal wrench (1.5 mm) into HH3×4 retaining M617 (pulley) and fix M625 (mirror holder) at the upper limit.**



9. **Adjust the mirror and holder shown in the figure below so that the four luminous spots will match with the reticle of the eyepiece jig.**


Move this mirror for adjustment in horizontal direction.
Turn this holder for adjustment in vertical direction.
Luminous spot
Reticle
Eyepiece jig

10. **Loosen the screws on the half mirror and mirror temporarily as shown in the figure below and fit the eyepiece jig for the CCD holder on the X side and adjust the horizontal direction by turning the half mirror.**
    * Luminous spot may be doubly seen, but adjust the left one.
    * Slide the jig and adjust the position of the luminous spot at both front and back. Pay special attention to the back side.
    * Adjustment by loosening or tightening the set screw is not made on the X side.



11. Fit the eyepiece jig for the CCD holder to the Y side and adjust the horizontal direction by turning the mirror so that the four luminous spots will match with the reticle of the eyepiece jig.
12. Disconnect the cables of the lamp jig and plug the interface cable into the original position.
13. Brighten the contrast on the monitor and make sure that the four reference holes of the jig are misaligned from the reticle. If so, readjust the optical axis.
14. Turn the power switch off and remove the jig.

The coarse adjustment is completed. According to "KM optical adjustment by signal check", perform the fine adjustment.

[KM optical adjustment by signal check]

Connect an oscilloscope and turn the power switch on.

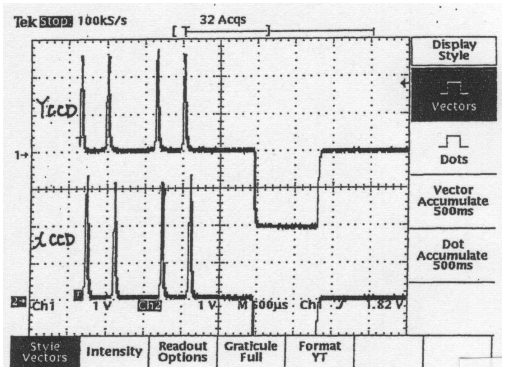
CH1	PC1 on TP14(X-CCD)
CH2	PC1 on TP15(Y-CCD)
CH3	PC1 on J107-A2pin(TRIG)
GND	GND
TIME	0.5msec/DIV
VOLTS	1V/DIV DC

Set the DIP switch No. 4 to the ON position. Press (R/K) (R/K button) to place the system in the KM measurement mode.

Align the system with the steel balls of R5.00 and R10.00 mm and press the START button.
Make sure that the waveform is within the following conditions.

1) Crest values of four waveforms are almost uniform.
2) Crest values of X CCD are 3V to 4V.
3) Crest values of Y CCD are 2.5V to 3.5V.

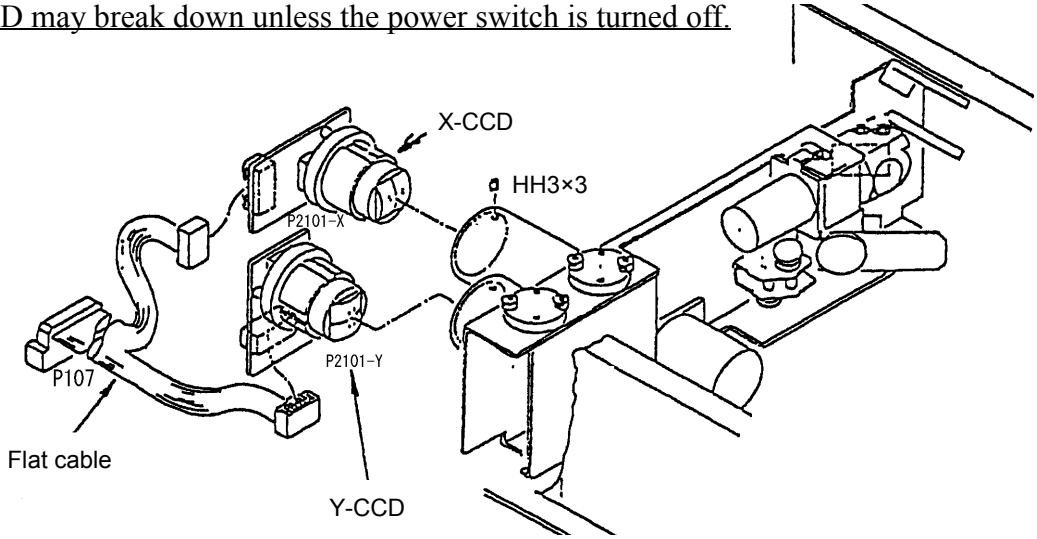
If these conditions are not met, perform the optical axis adjustment according to the following procedures.



1. Move the CCD so that it will be attached to the center of the holder.

2. Make the CCD surface parallel to the prism cylindrical surface for X side and Y side.
* Create clearance of 1.5 mm between the prism and holder.
* If waveforms are not outputted when checked with an oscilloscope, adjust the clearance of the holder between the prism and holder within the range of 1.0 mm to 1.5 mm. Tighten HH3×3 retaining M647 (cylinder prism holder).

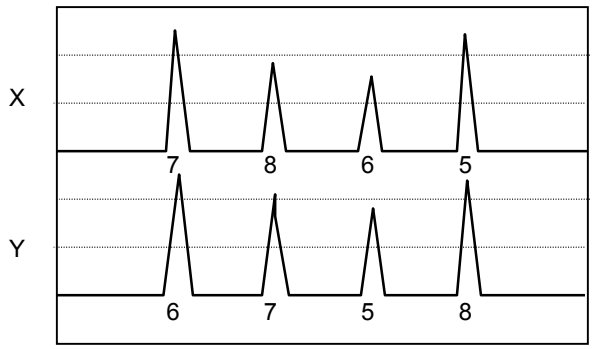
3. **After making sure that the power is turned off, connect the X-CCD, Y-CCD, and flat cable.**
   * The CCD may break down unless the power switch is turned off.

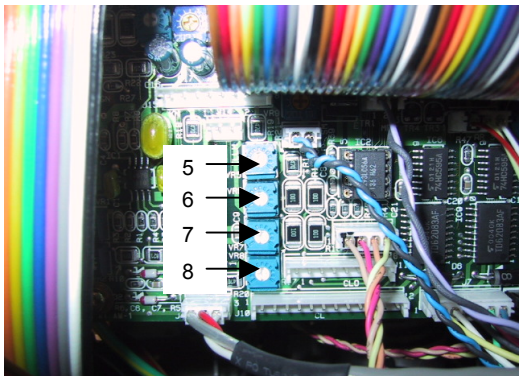


4. **Connect the oscilloscope and attach the model eye (steel ball) onto the chin rest.**
5. **Turn the power switch on.**
6. **Set the DIP switch No. 4 to the ON position. Press (R/K button) to place the system in the KM measurement mode.**
7. **Align the system with the steel balls of R5.00 and R10.00 mm and press the START button.**
   Make sure that the waveform is within the following conditions.
   1) Crest values of four waveforms are almost uniform.
   2) Crest values of X CCD are 3V to 4V.
   3) Crest values of Y CCD are 2.5V to 3.5V.

   If waveforms cannot be adjusted with VR5 – VR8, adjust the tilt of the half mirror and/or mirror.
   * For coarse adjustment, adjust the CCD. For fine adjustment, adjust the HH screw.

   Adjust the KM waveform with VR5 to 8 of 32906-BA22.



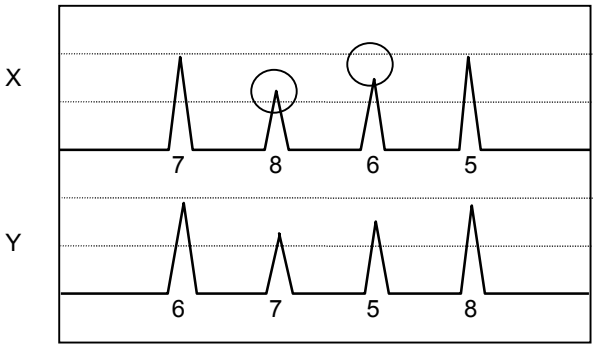


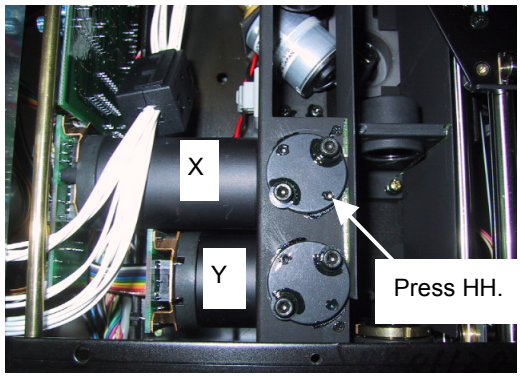
32906-BA22

* When it is difficult to adjust the KM waveform with VR, move the CCD.

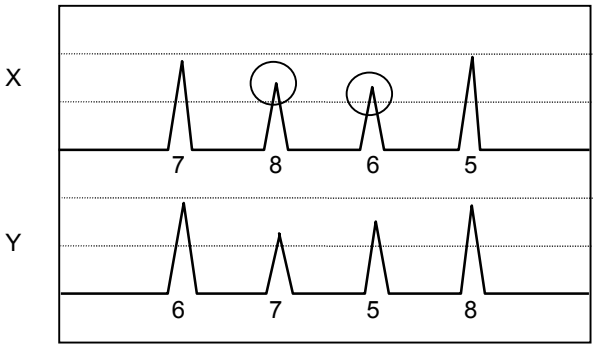
If the conditions are not met, adjust the rotation and tilt of the holder of the half mirror and/or mirror.
Only when of fine adjustment, adjust the tilt with the HH screw.

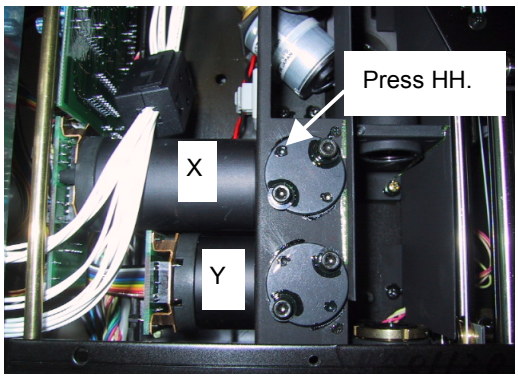
a) Heighten the waveforms of X6 and X8.



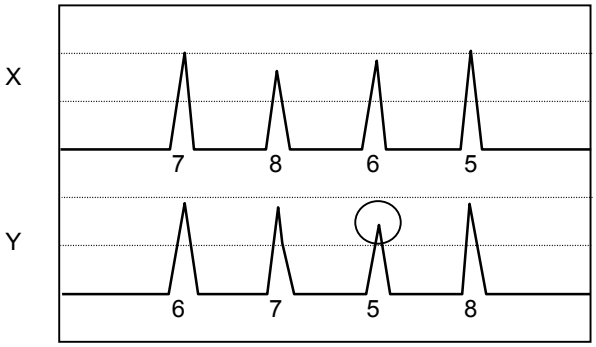


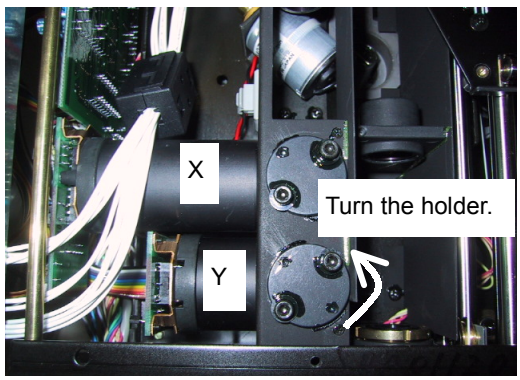
b) Heighten the waveforms of X6 and X8.



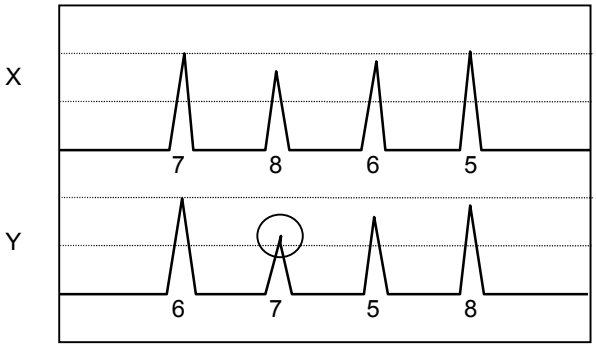


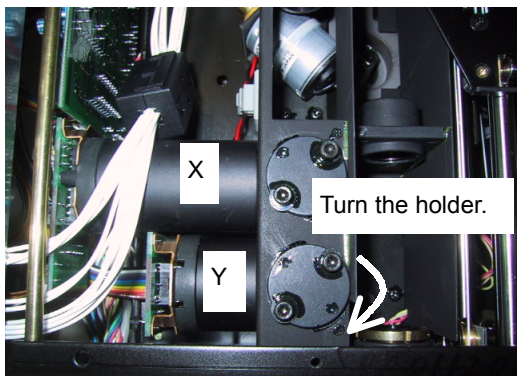
c) Heighten the waveform of Y5





d) Heighten the waveform of Y7

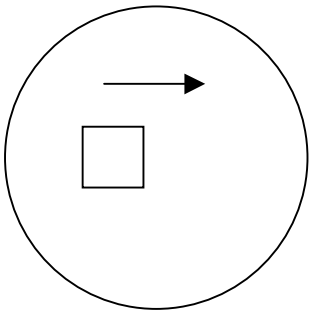




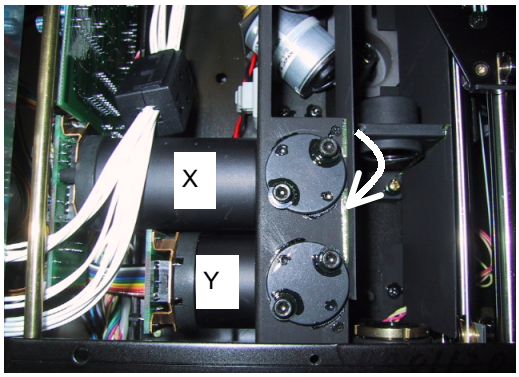
8. Check the KM measurable range.

If the measurable range is not even between the X side and Y side, follow the procedure below for adjustment.

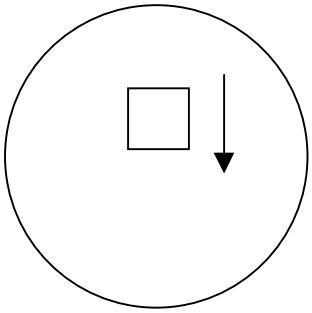
a. Move the reticle to the right



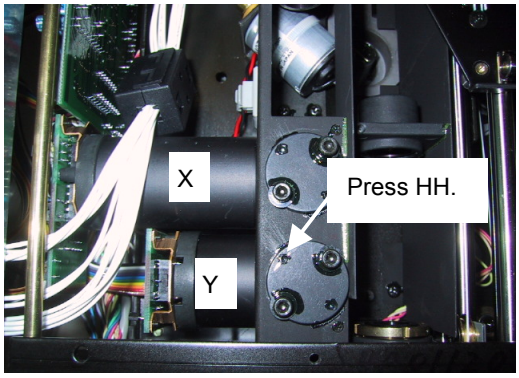
Turn the holder counterclockwise to move the reticle to the left.



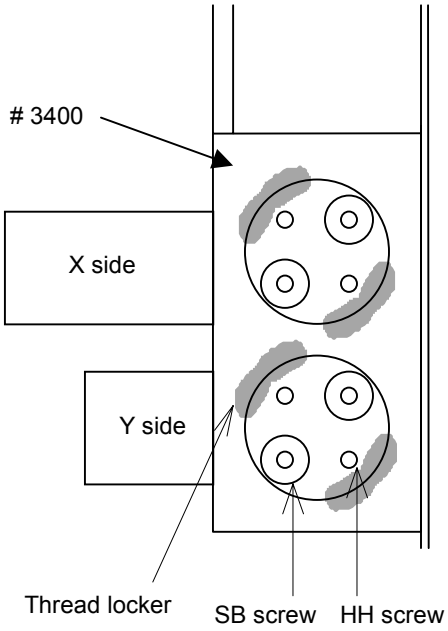
b. Move the reticle down



Press another HH to move the reticle up.



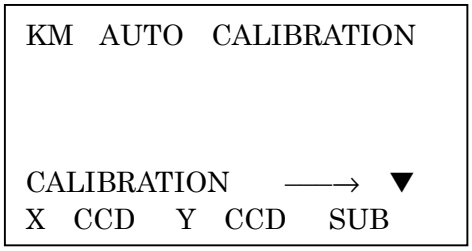
After adjustment, apply a threadlocker as shown on the right figure.



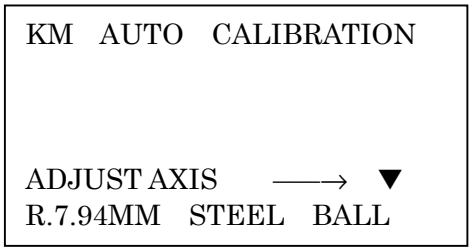
Use the steel ball of R5.00 mm for wavelength adjustment and the steel ball of R10.00 mm for range adustment.
After that, check the waveform of 7.49 mm, 5.95 mm, and 9.13 mm.

4.14 KM Calibration

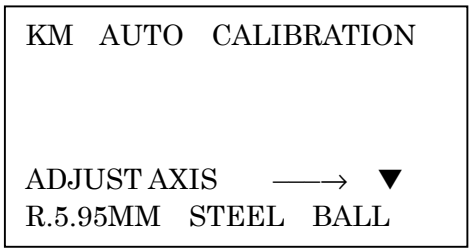
This adjustment must be made for the ARK-700 series.
Perform this calibration after cleaning the steel ball and measuring window.



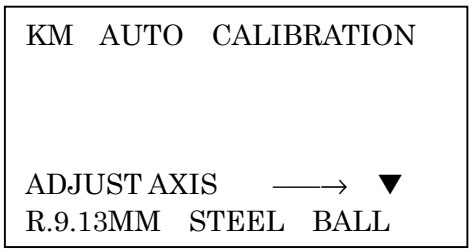
1. **Pressing (▼) (DOWN button) will change the display as shown on the right figure.**



2. **Align the system correctly with the steel ball of R7.94 mm and press the START button to start the 10 measurements.**
   The display will change as the right figure shows.



3. **Align the system correctly with the steel ball of R5.95 mm and press the START button to start the 10 measurements.**
   The display will change as the right figure shows.



4. **Align the system correctly with the steel ball of R9.13 mm and press the START button to start the 10 measurements.**
   The display will change as the right figure shows.

5. **Make sure that the results are within tolerances.**

Unit: mm

Model eye	R5.00	R5.95	R7.94	R9.13	R10.00
Tolerance	± 0.02	± 0.02	± 0.02	± 0.02	± 0.02
Difference between R1 and R2	0.04	0.04	0.04	0.04	0.04

6. **If the results are not within tolerance, perform auto-calibration again, paying attention to the alignment.**
   If the results are not within tolerance even after several auto-calibrations, readjust the KM axis.

KM AUTO CALIBRATION
MEAS CONTINUE→ START CHANGE▲/▼ENTER START OFFSET AXIS=+00/+00

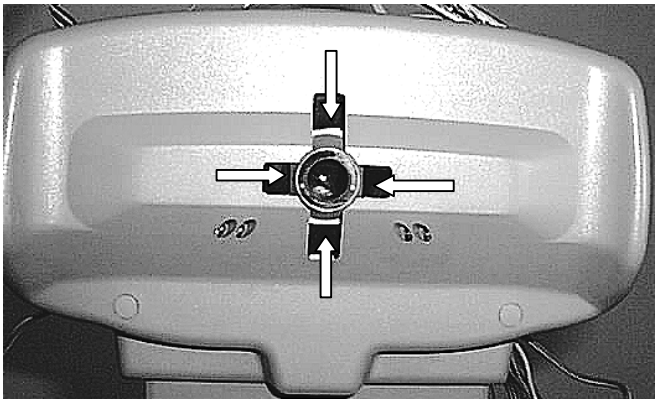
7. **Measure each steel ball and make sure that the results are within tolerance.**

8. **Check the measurable range with the steel balls of 5.00 mm and 10.00 mm.**

9. **Make sure that the sagittal measurement is possible.**

   Make sure that the red LED light by pressing (▼) (DOWN button).

   Each press of the button lights the red LED in turn. Press the button four times and the LED will light at four spots.
   Replace the LED if its illumination is abnormal.



LED: Four spots as the arrows show.

4.15 KM AXIS Check and Correction

Measure KM AXIS with an aspherical model eye (32171-0810) and make sure that the axis is within ±2º.
This check and correction must be performed to the ARK-700 series only.

[Check]

1) Attach the aspehrical model eye onto the chin rest horizontally.
2) Measure the model eye at 0º, 45º, 90º, and 135º and make sure that the results are within ±2º.
3) If not, perform **[Correction]** on the following page.

[Correction]

1) Set the DIP switch No. 4 to the ON position.

2) Press (R/K) (R/K button).

3) Press (▼) (DOWN button) twice. "+00/+00" is shown.

4) Change the value with (▲) or (▼) (UP/DOWN button).

5) Press (R/K) (R/K button) to place the system in the entry mode.

6) Set the DIP switch No. 4 to the OFF position.

7) Perform **[Check]** again.
Repeat **[Check]** and **[Correction]** until the results are within the standard value ±2º.

4.16 Tilt Adjustment of Chart

1. **Turn the power on and look at the chart.**
2. **Make sure that the chart is not tilted.**
   See "4.2 Opitcal Axis Adjustment of Chart" for details.

4.17 PD Adjustment

1. **Attach the center PD check jig onto the chin rest.**
2. **When the main body is fixed by the knob, make sure that the center deviation is within 2 mm (3 mm for test).**
   * For the AR-600A/AR-660A/ARK-700A/ ARK-760A, make this adjustment after turning the power off and then on again.

[AR-600A/AR-660A/ARK-700A/ARK-760A for Step 3 – 9]

3. **Turn the power switch off.**
4. **Turn the power switch on while holding (CYL) (CYL Mode switch) and (Eyeprint switch).**
5. **Press (Changing button).**
6. **Press the START button to establish "MODE13-0".**
7. **Press (Print button).**
8. **Press (Setting switch).**
9. **Press (CYL) (CYL Mode switch) and (Eyeprint switch) at the same time.**

[PD calibration]

10. **Press the START button to establish MODE 13.**
11. **Perform the 64 mm calibration with a scale of the jig.**
12. **Align the reticle with the reference line on the left of the scale and press (Print button).**
13. **Slide the body 64 mm to the right side to align the reticle with the scale and press (Print button).**
14. **If 64 appears, the calibration is successful. If not, readjust with (▲) or (▼) (UP/DOWN button) and check again.**
15. **Press (Setting switch).**
16. **Press (CYL) (CYL Mode switch) and (Eyeprint switch) at the same time.**

4.18 Auto-Tracking Adjustment

This adjustment must be made to the AR-600A/AR-660A/ARK-700A/ARK-760A.

1. **Turn the power switch on while holding CYL (CYL Mode switch) and (Eyeprint switch).**

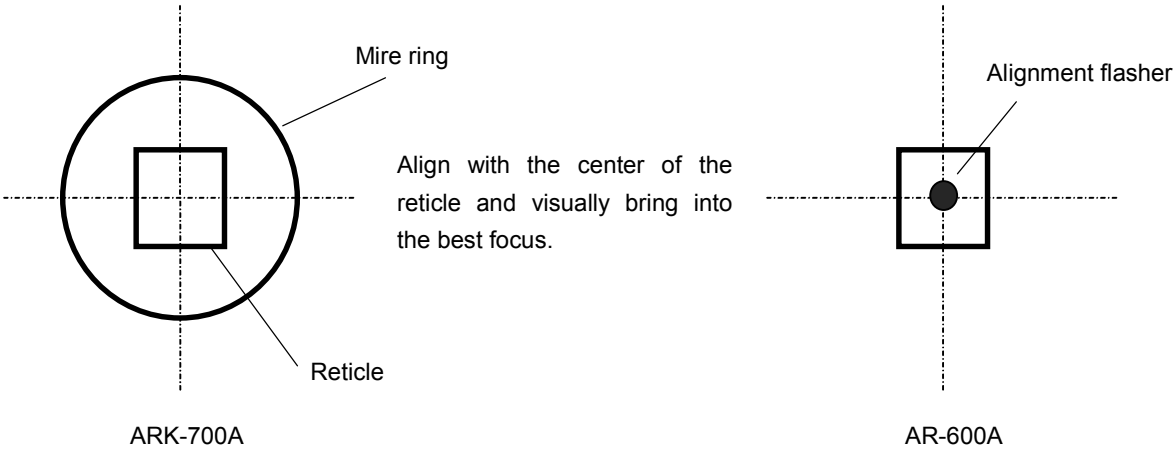
2. **Set the DIP switch No.6 to the ON position.**
   * OFF for AR series.

3. **Attach the cemented model eye.**

4. **Establish "TRC ADJUST MODE 30".**
   Press (Auto-tracking button) to change the Axis indication on the display to "30".

5. **Align the system with the 0D model eye and bring in focus and then press (Auto-shot button).**

6. **When the auto-tracking ON mark appears, press (Setting switch) and then press CYL (CYL Mode switch) and (Eyeprint switch) at the same time.**



[Adjustment of minimum cornea reflection model eye]

7. **Attach the tracking model eye.**
   Align the system with the model eye and adjust the light quantity of the LED in the adjustment mode 34, 35 or 37 (AR-600A), and 34 or 35 (ARK-700A) so that the focus bars will be all stably displayed.

8. **After adjustment, perform Step 1 to 6 again.**

[Adjustment avoiding tracking error during the AR measurement]

9. **Make sure that a tracking error does not occur with the model eye +23D during the AR measurement.**
   If an error occurs, adjust the gain of the CCD camera. Perform **[Adjustment of minimum cornea reflection model eye]** again.

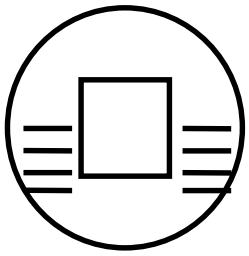
4.19 Auto-Shot Adjustment

This adjustment must be made to AR-600A/AR-660A/ARK-700A/ARK-760A.

1. **Press (Auto-tracking button). (appears on the display.)**

2. **Align the system with the cemented model eye (0D).**

3. **From the position where the body is placed toward you, bring the eye into focus gradually.**



Make sure that the measurement is started when one focusing indicator is shown.

→ → → (Measurement)

Turn VR9 until the four focus indicators appear.

[AR-600A and AR-660A]

Do not turn VR9 to the right of one o'clock position.

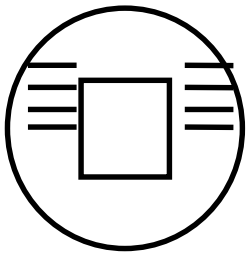
It may be turned if the voltage on each end of PC6 R22 and R23 is 1.1V or less.

[ARK-700A, ARK-760A]

Do not turn VR9 to the right of two o'clock position.

It may be turned if the voltage on each end of PC6 R22 and R23 is 1.1V or less.

4. **From the position where the body is placed backward, bring into focus gradually.**



Make sure that one focusing indicator is shown at the start of the measurement as above.

5. **Perform the same procedure for the +23 model eye.**
   * Make sure that one or two focus indicators are not shown when the auto-shot is performed.

6. **Make sure the number of the focusing indicators for the tracking model eye.**

4.20 Chart Calibration/CYL Lens Adjustment

This adjustment must be made to the AR-660A and ARK-760A only.

[1. Preparation]

1. **Look into the eyepiece of the chart calibration check jig and adjust the visibility looking at the white wall.**

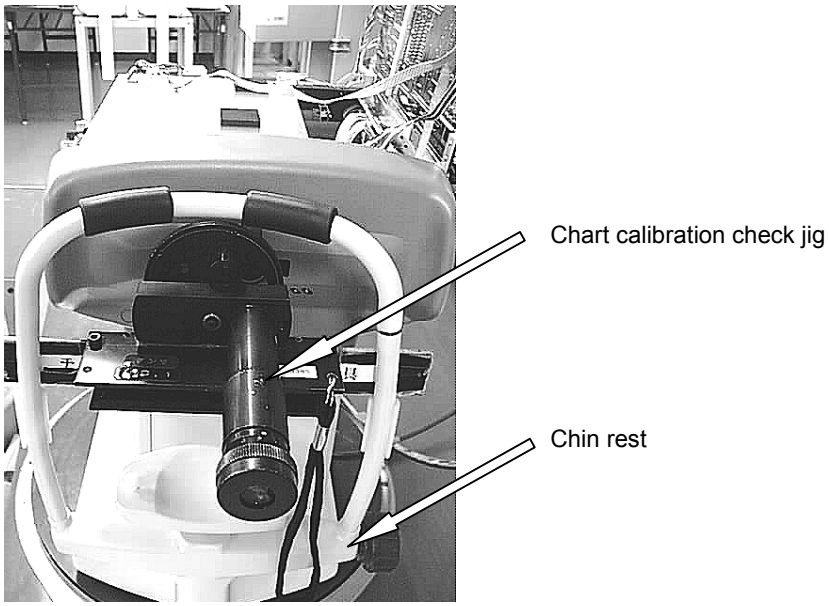
   How to adjust the visibility of the dioptic tester

   1) Draw out the power ring adjustable eyepiece of the dioptric tester to blur the view. (*State that the power ring adjustable eyepiece is fully turned counterclockwise.)

   2) Turn the eyepiece clockwise while looking into the dioptric tester and stop turning at the position where the scale of the reticle is clearly shown.
      * Correct adjustment cannot be made by turning counterclockwise due to the interference of accommodation.
      Persons with astigmatism must be corrected by wearing correct glasses for this adjustment.

   3) If the power ring adjustable eyepiece is turned too much, repeat Step 2) after turning the adjustable eyepiece of the dioptric tester fully counterclockwise again to blur the view.
      * In such a case, it is not allowed to bring into focus from that (or returned) position. It may cause a visibilty failure.

2. **Attach the chart calibration check jig on the chin rest.**

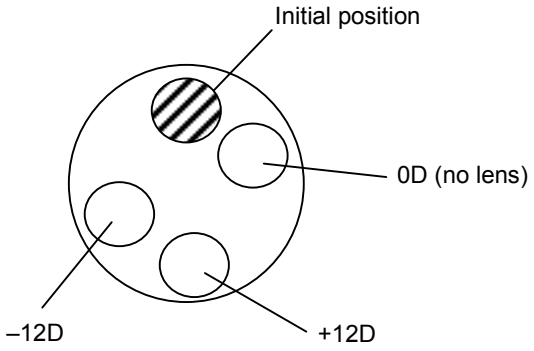


3. **Turn the power switch on while holding CYL (CYL Mode switch) and (Eyeprint switch).**
   → The system is placed in the adjustment mode.

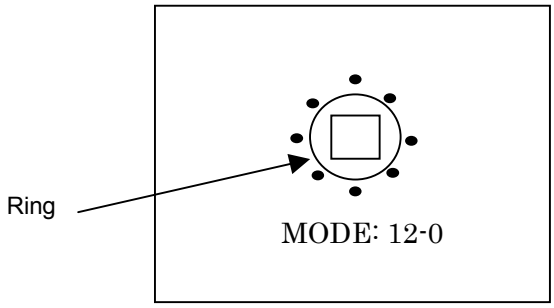
4. **Press (Changing button).**

5. **Press the button on the joystick to establish "AXIS 12".**

6. **Set the chart calibration jig at the initial position (with model eye).**



7. **Bring the ring to the center by moving the joystick all around while checking on the TV monitor.**
   Lock the main body with the locking knob.



[2. Calibration adjustment of 0D]

1. **Set the chart calibration jig at the 0D (no lens) position.**

2. **Make sure that the TV monitor shows "MODE: 12-0".**
   If not, press the button on the joystick to change the display indication.

3. **Hold (Changing button) until the chart goes out of focus, looking into the dioptric tester of the jig.**
   (The SPH value indication increases.)

4. Watch the yellow part of the balloon chart, looking into the dioptric tester of the jig.

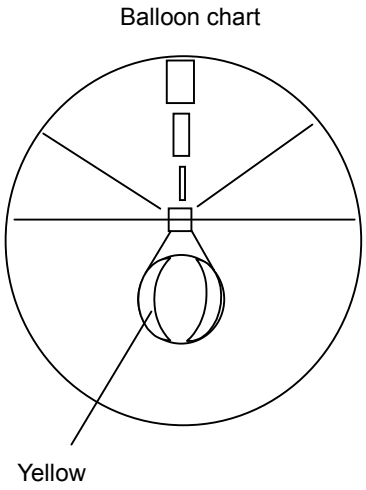
Hold (R/K button) until the balloon chart comes into focus.

(The SPH value indication decreases.)

When the balloon is in focus, black dots are shown on the balloon chart.

SPH value + direction → Press (Changing button) or (▲).

SPH value – direction → Press (R/K button) or (▼).



5. Press the button on the joystick twice to establish "MODE:12-2".

6. Set the chart calibration jig at 0D.

Bring the balloon chart into focus by pressing (Changing button) or (R/K button) while looking into the dioptric tester of the jig.
Check the shift on the SPH value indication.

7. Set the chart calibration jig at +12D.

Press (Print button) to set +12D.

Bring the balloon chart into focus by pressing (Changing button) or (R/K button) while looking into the dioptric tester of the jig.
Check the shift on the SPH value indication.

8. Set the chart calibration jig at –12D.

Press (Print button) to set –12D.

Bring the balloon chart into focus by pressing (Changing button) or (R/K button) while looking into the dioptric tester of the jig.
Check the shift on the SPH value indication.

9. Make sure that the values checked in Step 6 - 8 (0D, +12D, –12D) are within spec.

Within spec → Step 13
Out of spec → Step 10

Diopter	Spec
0D	±0.10
+12D	–0.20 +0.25
–12D	±0.20

10. Press (CYL) (CYL Mode switch) to establish "MODE: 12-0"

Set the calibration jig at 0D (no lens).

Press (Print button) to set 0D.

Bring the balloon chart into focus by pressing (Changing button) or (R/K button) while looking into the dioptric tester of the jig.

11. Press the button on the joystick to establish "MODE:12-1".

Press (Changing button) or (R/K button) to change the GAIN value (displayed at SPH).

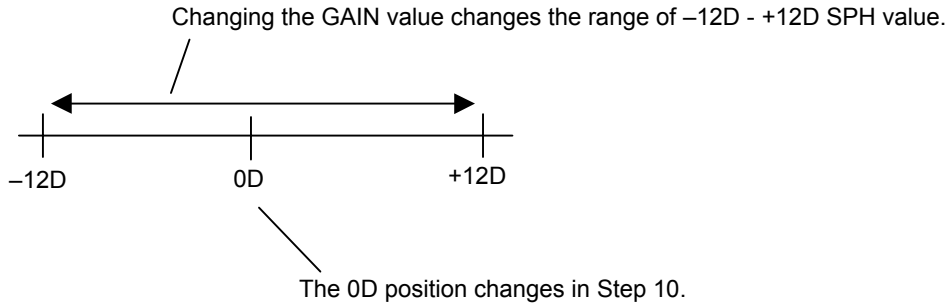
e.g. of adjustment)

Diopter	SPH value (before change)
+12D	+11.80
–12D	–11.80

Increase the GAIN value from +0.12 to +0.18.

* The GAIN value is changed in 0.02 increments.
* Changing the GAIN value by 0.02 changes the SPH value by about 0.05.

Reference)



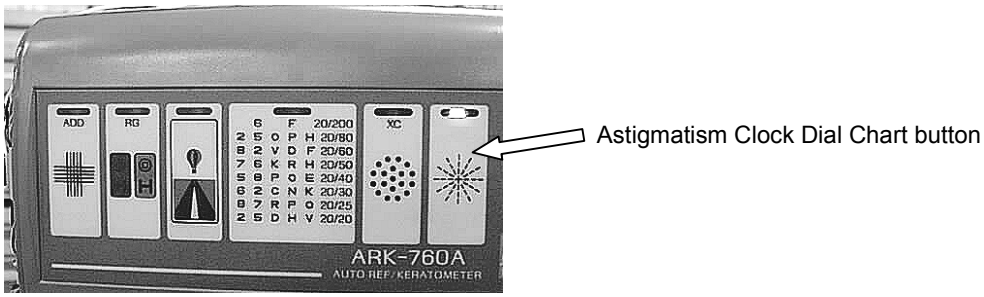
12. Make sure that the values checked in Step 6 to 9 are within spec.

13. Press (Setting switch).

Press (CYL) (CYL Mode switch) and (Eyeprint switch) at the same time.

The adjusted values will be stored in memory.

14. Press the Astigmatism Clock Dial Chart button to select the Astigmatism Clock Dial chart.

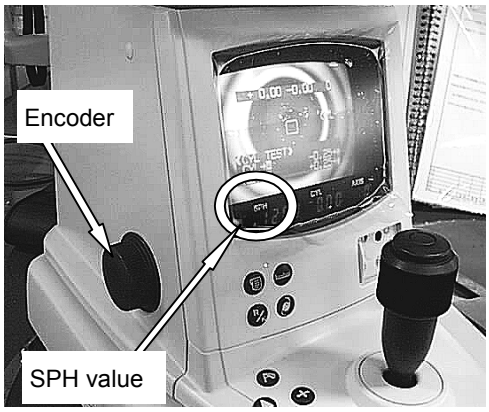


15. Make sure that the chart is not out of focus at 0D, +12D, and –12D.
Follow the procedure of the balloon chart (Procedure in Step 5 - 9).
[When the chart is out of focus]
1) Adjust the 0D position in "MODE: 12-0".
2) Make sure both of the balloon chart and Astigmatism Clock Dial chart are not out of focus at 0D, 12D, and –12D.

[3. Out-of-focus check in subjective mode]

1. Press the Astigmatism Clock Dial Chart button.
→ (The system is placed in the subjective mode.)
Press (Changing button) twice. → (The SPH value indication flashes.)

2. Set the chart calibration jig at 0D.
Turn the encoder to bring the Astigmatism Clock Dial chart into focus while looking into the dioptric tester.
When the Astigmatism Clock Dial chart is in focus, make sure that the SPH value indications on the TV monitor shows "0.00".
If not, perform [2. Calibration adjustment of 0D] again.



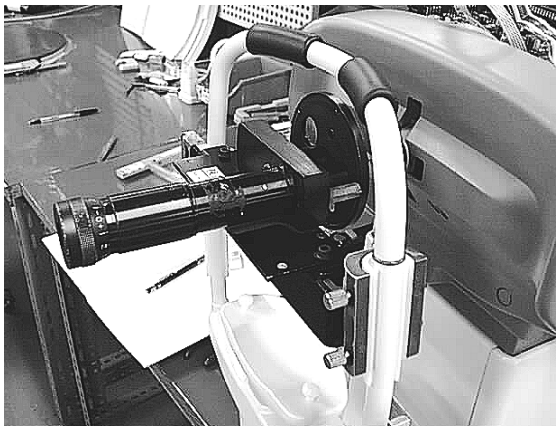
3. Set the chart calibration jig at +12D.
Turn the encoder to bring the Astigmatism Clock Dial chart into focus while looking into the dioptric tester.
When the Astigmatism Clock Dial chart is in focus, make sure that the SPH value indications on the TV monitor shows "+12.00".
If not, perform [2. Calibration adjustment of 0D] again.

4. Set the chart calibration jig at –12D.
Turn the encoder to bring the Astigmatism Clock Dial chart into focus while looking into the dioptric tester.
When the Astigmatism Clock Dial chart is in focus, make sure that the SPH value indications on the TV monitor shows "–12.00".
If not, perform [2. Calibration adjustment of 0D] again.

[4. Adjustment of CYL lens]

1. **Adjust the visibility of the CYL lens adjustment jig.**

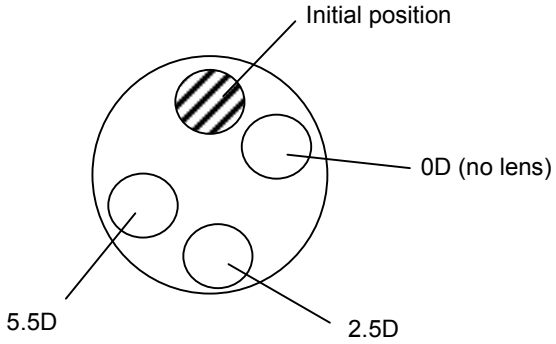
2. **Attach the CYL lens adjustment jig on the chin rest.**



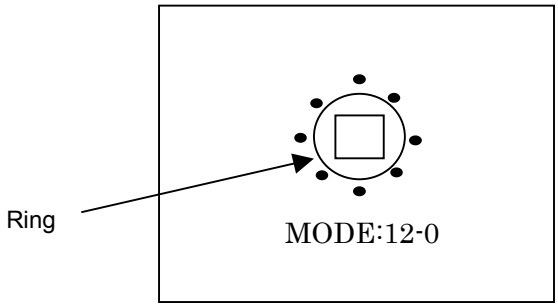
3. **Press ▲ (UP button) in the adjustment mode.**

   "CYL:LENS" will be seleted.

4 **Set the CYL lens adjustment jig at the initial position (with model eye).**



5. **Operate the joystick all around to bring into focus and center the ring while looking at the display on the TV monitor.**
   Lock the main body with the locking knob.



6. **Set the CYL lens adjustment jig at 0D.**

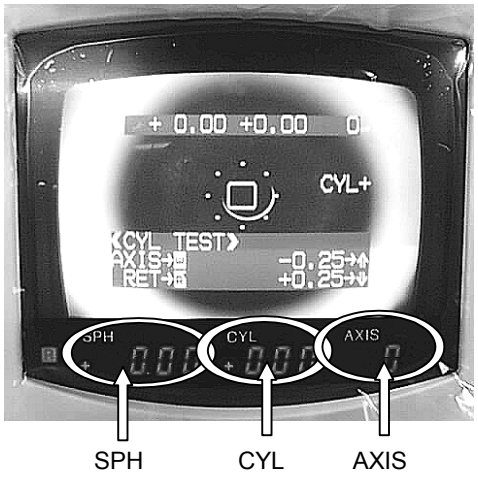
7. **Make sure that the AXIS indication shows "60" on the TV monitor.**
   If not, press the joystick to set "60".

8. **Bring the Astigmatism Clock Dial chart into focus by pressing ▲ or ▼ (UP/DOWN button) while looking into the dioptric tester.**

9. **Press A (Auto-shot button) to set the CYL indication at 1. Make sure that the Astigmatism Clock Dial chart is not out of focus while looking into thedioptric tester.**

   Press A (Auto-shot button) to set the CYL indication at 2. Make sure that the Astigmatism Clock Dial chart is not out of focus while looking into thedioptric tester.

   Press A (Auto-shot button) to set the CYL indication at 3. Make sure that the Astigmatism Clock Dial chart is not out of focus while looking into the dioptric tester.



   Press A (Auto-shot button) to set the CYL indication at 0.
   Make sure that the Astigmatism Clock Dial chart is not out of focus while looking into the dioptric tester.

   Adjust the SPH indication by pressing ▲ or ▼ (UP/DOWN button) so that the chart will be focused at the four points of CYL 0 – 3 in Step 8 – 9.

10. **Press the button on the joystick to set the AXIS indication at "61".**

11. **Set the CYL lens adjustment jig at 5.5D.**

12. **Look at + of the Astigmatism Clock Dial chart and make sure that focus is achieved in all directions.**
    If not, adjust the SPH indication by pressing ▲ or ▼ (UP/DOWN button) to attain focus in all directions.

13. **Press the button on the joystick to set the AXIS indication at "60" to make sure that 0D is not shifted. (Step 6 – 9)**

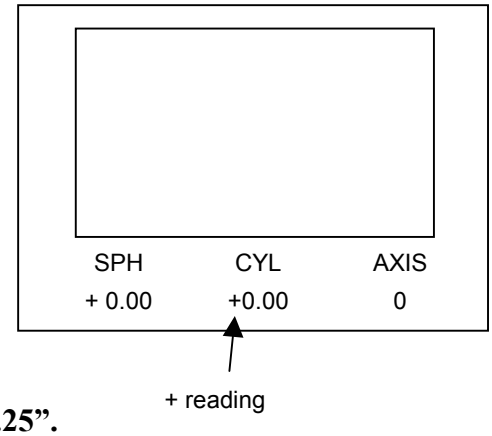
14. **Press (Setting switch).**

15. **Press CYL (CYL Mode switch) and (Eyeprint switch) at the same time. The adjusted values will be stored in memory.**

Follow the procedure below in the normal mode instead of the adjustment mode.

1. **Press the Astigmatism Clock Dial Chart button.**

2. **Press (CYL) (CYL Mode switch) to set the CYL indication at +.**



3. **Turn the encoder to set the CYL indication at "+0.25".**

4. **Press (Changing button). → (The AXIS indication flashes.)**

5. **Turn the encoder to set the AXIS indication at "90".**

6. **Press (Changing button) twice. → (The CYL indication flashes.)**

7. **Set the CYL lens adjustment jig at 0D.**
   Make sure that the Astigmatism Clock Dial chart is in focus while looking into the dioptric tester.

8. **Set the CYL lens adjustment jig at 2.5D.**

9. **Turn the encoder to bring the Astigmatism Clock Dial chart into focus while looking into the dioptric tester.**
   Make sure that the CYL indication on the monitor shows +2.50 - +2.75.
   If not, → Perform [3. CYL lens adjustment] again.

10. **Set the CYL lens adjustment jig at 5.5D.**

11. **Turn the encoder to bring the Astigmatism Clock Dial chart into focus while looking into the dioptric tester.**
    Make sure that the CYL indication on the monitor shows +5.50.
    If not, → Perform [3. CYL lens adjustment] again.

After [4. CYL Values Adjustment], make sure that there is no error in [2. Calibration Adjustment of 0D]. If there is, make a readjustment.

5.1 DIP Switch Function Table

AR-600(A)/ARK-700(A) DIP SW Function Table

•DIP SW function

SW No.	Function	OFF	ON
1	NOT USE	Disable	Disable
2	NOT USE	Disable	Disable
3	RESERVE (Switching optional chart)	No chart as option	Chart as option
4	Adjustment mode (AR,KM,OTHER)	Normal mode	Adjustment mode
5	Light ON/OFF	Light ON	Light OFF
6	Switch of sagittal specifications (KM model)	No sagittal	Sagittal specifications
7	Switching printer (Line printer/Serial printer)	Line printer	Serial printer
8	IN port (Enable/Disable)	Enable (LM)	Disable (IC card)

AR-660A/ARK-760A DIP SW Function Table

•DIP SW Function

SW No.	Function	OFF	ON
1	NOT USE	Disable	Disable
2	NOT USE	Disable	Disable
3	Switching Home/Overseas chart	Home chart	Overseas chart
4	Adjustment mode (AR,KM,OTHER)	Normal mode	Adjustment mode
5	Light ON/OFF	Light ON	Light OFF
6	Switching Sagittal specifications (KM model)	No sagittal	Sagittal specifications
7	Switching printer (Line printer/Serial printer)	Line printer	Serial printer
8	IN port (Enable/Disable)	Enable (LM)	Disable (IC card)

ROTARY SW Function Table

•ROTARY SW Function

No.	Design code	Model name
0	AR-10	AR-600
1	AR-10A	AR-600A
2	AR-10B	AR-660A
3	NOT USE	NOT USE
4	NOT USE	NOT USE
5	RK-4	ARK-700
6	RK-4A	ARK-700A
7	RK-4B	ARK-760A
8	NOT USE	NOT USE
9	NOT USE	NOT USE

The rotary switch determines the program function.

5.2 Error Code Table

Error code	Display: No code	Display: Code	Error	Description
1	Err	Err 1	Sensor error	Abnormal sensor travel.
2	Err	Err 2	Target error	The target limit switch does not turn on.
3	Err	Err 3	Rotator error	The rotator limit switch does not turn on.
4	Err	Err 4	Chart error	The chart sensor does not turn on.
5	Err	Err 5	CL1 error	The cylinder lens 1 sensor does not turn on.
6	Err	Err 6	CL2 error	The cylinder lens 2 sensor does not turn on.
7	Err	Err 7	Printer error	Paper-out or lever remains up. (at line printing)
8	Err	Err 8	Printer error	HOME switch does not turn on. (at serial printing)
9	Err	Err 9	E2PROM error	E2PROM data is corrupted.
A	Err	Err a	RAM error	Backup data of RAM is corrupted.
B	Err	Err b	TV camera error	No a synchronizing signal.
C	Err	Err c	PC22 communication error	Communication with PC22 board cannot be done.
D	Err	Err d	CLOCK error	Abnormal clock data.
11	Err	Err 11	DSR error (OUT)	DSR is not set when SD command is issued.
12	Err	Err 12	DSR error (OUT)	DSR is not set when data is transmitted.
13	Err	Err 13	Data error (OUT)	Data is not received.
14	Err	Err 14	Overflow (OUT)	Reception buffer is full.
15	Err	Err 15	Command error (OUT)	Indecipherable command is received.
16	Err	Err 16	Data empty (OUT)	There is no data to be sent.
18	Err	Err 18	DSR error (IN)	DSR is not set when SD command is issued.
19	Err	Err 19	DSR error (IN)	DSR is not set when data is transmitted.
1A	Err	Err 1a	Data error (IN)	Data is not received.
1B	Err	Err 1b	Overflow (IN)	Reception buffer is full.
1C	Err	Err 1c	Command error (IN)	Indecipherable command is received.
81	Err	Err 81	Blink error	Blink error by mask signal.
82	Err	Err 82	Blink error	Blink error 2 by mask signal.
83	Err	Err 83	Blink error	Blink error by SGRAD waveform.
84	Err	Err 84	SGRAD error	Error by gradient coefficient.
85	Err	Err 85	Blink error	Blink error by mask signal during measurement.
86	Err	Err 86	Blink error	Blink error by measuring waveform during measurement.
87	Err	Err 87	Blink error	Blink error by measured results.
91	Err	Err 91	SPH + failure	+23D or more (when VD is 12 mm)
92	Err	Err 92	SPH – failure	–18D or less (when VD is 12 mm)
93	Err	Err 93	CYL failure	8D or less (when VD is 12 mm)
94	Err	Err 94	Confidence coefficient error	
A1	ERROR	ERROR A1	Inadequate CCD light error	Measuring light does not get in the CCD.
A2	ERROR	ERROR A2	CCD edge short error	Measuring light of X or YCCD is two or less.
A3	ERROR	ERROR A3	CCD edge excess error	Measuring light of X or YCCD is five or more.
A4	ERROR	ERROR A4	CCD waveform error	Measuring light is too wide.
A6	ERROR	ERROR A6	Abnormal CCD edge count error	The number of measuring lights is different between X and YCCD.
B1	ERROR	ERROR B1	R (corneal curvature) + failure	10.06 mm or more
B2	ERROR	ERROR B2	R (corneal curvature) – failure	4.94 mm or less
B3	ERROR	ERROR B3	CYL (corneal) failure	10.00D or more
C1	ERROR	ERROR C1	Inadequate sagittal value error	Inadequate sagittal value for eccentricity calculation.

* Error code 9 and A can be printed out.

9:Memory Failure on E2PROM, A:Memory Failure on RAM

5.3 Switch Operation at Power ON

The following switch operation at power ON will place the system into a desired mode.

Switch operation	Description
SET	Prints out the adjustment contents (E2PROM) and parameter settings. Goes into the parameter setting mode. Comment can be entered in this mode. Comment cannot be entered when the parameter setting mode exits.
SET + EYE PRINT	Goes into the edit mode of the E2PROM setting information. PRINT SW: Digit change SCALE SW: Value UP IOL SW: Value DOWN START SW: Next item CYL SW: Previous item EYE PRINT: Prints the setting. SET SW: Stores edit results in E2PROM. Turning the power switch off and on will exit from this mode.
START	RS232C circuit check mode Use a short jig for both of IN and OUT ports. Turning the power switch off and on will exit from this mode.
START + DSW4: ON	E2PROM erase mode Releasing the START switch and turning DSW off while holding the START switch again will erase the contents of E2PROM.
CL SEL	While CL SEL switch is held down, all of the LED displays will illuminate.
CL SEL + EYE PRINT	Auto TV off 10 seconds mode Turning the power switch off and on will exit from this mode.
CL SEL + CYL	RETICLE position adjustment mode PRINT SW: Moves to the left. SCALE SW: Moves to the right. CL SEL SW: Moves up. CYL SW: Moves down. CYL+EYE: Stores results in E2PROM at the present adjustment position. Turning the power switch off and on will exit from this mode.
CYL + EYE PRINT	Goes into the adjustment mode. Same operation as DSW4:ON Pressing CYL + EYE PRINT on the MENU display in the adjustment mode will store the setting and exit from this mode.
CYL + IOL	AR correction factor adjustment mode CL SEL + ▲ (or SCALE) SW: + side correction factor UP CL SEL + ▼ (or R/K or IOL) SW: + side correction factor DOWN CYL + ▲ (or SCALE) SW: – side correction factor UP CYL + ▼ (or R/K or IOL) SW: – side correction factor DOWN CYL + EYE PRINT: Stores correction factor value in E2PROM. Turning the power switch off and on will exit from this mode.
CYL + SCALE	Debug mode Disables KM three-point measurement mode. Error when only three points of measurement are detected. Drive power check of the sensor drive. EYE PRINT SW: DIN measurement SLOW/FAST switching CL SEL SW: AR waveform data output PRINT SW: Prints out values such as AR data + SGRAD, etc. Current SPOT value and last-measured GRAD value are displayed on the TV monitor. Turning the power switch off and on will exit from this mode.
PRINT	Self-check mode
AUTO SHOT	Tracking R/L adjustment (at assembly) At power on, centering command is not sent to the PC22. Auto-off disabled. Turning the power switch off and on will exit from this mode.

Others: The following is the special mode by switch operation after startup of the system.

Switch operation	Description
SET→BEEP + PRINT	Prints out the parameter.
SET→BEEP + CYL	Initializes the parameter.

*Specification and design are subject to change without notice for improvement.

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